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The Mississippi River Commission has reported upon the advisability of cutting off entirely the present communication of the Red River with the Mississippi River and compelling the first-named river to find its way to the Gulf by the Atchafalaya River. The majority report favors this separation, and says that the natural tendency is in that direction. Satisfactory connection for navigation between the Mississippi and Red rivers could be afforded by locks on Bayou Plaquemine, and the improvement of that bayou and the Atchafalaya River. The difficulty presented would be the necessity for heavier levees below Red River, as that stream now carries much of the flood water of the Mississippi to the mouth of the Atchafalaya River, and down that stream to the Gulf. Lieut.-Col. Suter, in a minority report, recommends artificial communication by canal between the two rivers, as the only possible solution of the difficulty. The canal already authorized by Congress to connect the Mississippi River with Bayou Plaquemine could, he thinks, be made to furnish all the necessary accommodation for Red River commerce. He believes the closing of the Red River both desirable and necessary, but says that the Plaquemine Canal should be pushed to completion.

The late Congress provided for the appointment of a national commission to examine into and report upon the proposed ship-canal between the Great Lakes and the Atlantic. But Congress also provided that the commissioners should receive nothing but their actual traveling and necessary expenses, to be paid out of an appropriation of $10,000 made for this purpose. The trouble now is to obtain two civilian commissioners willing to serve under these conditions; one of the three commissioners may be an officer of the army or navy. The Canadian authorities, who are invited by the text of the bill to co-operate with the commission appointed by the President of the United States, are investigating the same question, independently at present. But Canada proposes a deep waterway through Canadian territory entirely. It is understood, however, that they will appoint a commission to act with the one from the United States—when the latter can be found.

The Philadelphia, People's and Electric Traction companies of Philadelphia have been consolidated under one management, with a capital of $30,000,000, and the name of the Union Traction Co. Mr. John Lowber Welsh has been selected as President. The Philadelphia Traction Co., represented by Messrs. Widener, Elkins, Dolan, McManus and Altemus, will hold 310,000 out of the 600,000 shares of new stock. This deal practically brings all the street railways of Philadelphia under one control, and as a result a number of unprofitable lines will be stopped. The length of the consolidated system, including 18 miles of the Hestonville railway yet to be arranged with, is 276½ miles, on which are operated over 2,000 cars. The property is valued in the aggregate at about $60,000,000. In the year ending June 30, 1894, this system carried 177,948,762 passengers, and the aggregate receipts were nearly $10,000,000. The receipts of the three companies first named were $8,109,713, against $5,184,510 operating expenses.

A high-speed electric railway is projected between Baltimore and Washington, a distance of 40 miles. Sixty miles an hour is stated to be the speed at which the cars will be run.

The most serious railway accident of the week was caused by the collapse of a trestle under a freight train on the Atchison, Topeka & Santa Fe R. R., near Monument, Colo. The repair gang was at work on the north end of the structure. The train consisted of 24 cars of stone and lumber, and had nearly reached the south end when the timbers gave way and the entire train went down. Three persons were killed and 15 injured, three fatally. The structure was 300 ft. long and 50 ft. high.—The engine of a freight train on the Western New York & Pennsylvania R. R. jumped the track at Tuscarora, N. Y., July 17, and was followed by 12 out of the 33 cars. Two men were killed.

The first train on the electric railway from Niagara Falls to Lewiston, N. Y., on the American side of the gorge, jumped the track near Lewiston, July 18, and the rear car rolled half way into the water. Six persons were injured, two seriously. The train was being hauled by a locomotive, the overhead wiring not having been completed.

A sewer trench in Harrison, N. J., just across the river from Newark, caved in July 18, killing two men and seriously injuring five others. A similar accident had occurred about a week before, and the chief of police had warned the foreman and superintendent to have the sides of the trench properly supported. The trench is said to have been 10 ft. deep and 4 ft. wide. The contractors were Thomas J. Regan & Co.

A collision between the steamers "Ortigia" and "Maria P" occurred July 21 near the mouth of the Gulf of Spezia, Italy, and the latter vessel sank in a short time, nearly 150 persons being drowned. The night was dark, and it is said the "Ortigia" cut the other vessel nearly in two. Most of the persons drowned were Italian emigrants bound for Genoa, where they were to take a steamer for South America.

The sinking of the caissons for the piers of the Pennsylvania R. R. bridge over the Delaware River near Bridesburg, Pa., has been considerably interfered with by high tides. The drawspan caisson, No. 4, had been moored some months ago and the work of sinking had been commenced, when on June 22 an extraordinarily strong tide swept it from its moorings and carried it up stream fully 1,800 ft. The caisson was secured and allowed to remain at the point where the tide had carried it until the work of sinking No. 5 caisson should be finished. That work was completed recently, and an effort was made to bring the runaway caisson back to its position. Several powerful tugs failed to move it on account of its great weight, and it was then decided to lighten it. To do this, it was necessary to remove about 6 ft. of concrete that had already been placed in it. This was a tedious work, as the concrete had to be blasted out with dynamite, without damaging the caisson. When the concrete was removed six powerful tugs towed the caisson back into position. About two weeks ago a heavy tide wrenched caisson No. 2, which is located about the middle of the river, from its moorings and turned it upside down. The caisson was being sunk, and had 3 ft. of concrete piled upon it. A steam dredge is now excavating a trench in the bottom of the river adjoining the caisson, into which it is expected to pull it and right it. Caisson No. 5 has been sunk to the rock bottom of the river; the air chamber has been sealed, and five courses of masonry project above the surface of the water. No. 3, the last of the big caissons, was launched at Tacony last week, and will be towed down the river and placed in position shortly.

The wooden bulkhead of a small reservoir dam on the Yantic River near Norwich, Conn., failed on July 17. The dam was an old one, which in 1881 had been pressed into service in connection with the Norwich water supply. Previous to 1894 the city diverted the stream only when there was a surplus of water in the river, the water flowing through a wooden bulkhead at other times. This bulkhead was alternately wet and dry, and gave way on the date named above under a water pressure reported as only 6 to 7 ft. We are indebted to Mr. C. E Chandler, City Engineer of Norwich, for the information regarding the character of the dam and the cause of the failure.

The torpedo boat "Ericsson" met with a serious accident while running near New London on July 17. The boat was running at high speed with about 250 lbs. steam pressure, when the starboard low-pressure cylinder was wrecked and a break made in the pass-over pipe, from which steam poured into the engine room, scalding five men severely and five others slightly. The history of the "Ericsson" thus far has been a series of delays and accidents. Authorized in 1891, she was built by the Iowa Iron Works, of Dubuque, Iowa. She received the finishing touches in St. Louis, and sailed from there Aug. 8, 1894, to the Brooklyn Navy Yard, taking the "inside passage," traversing the Mississippi River, through bayous, canals, etc., to Tampa Bay. In New York Harbor her propeller blades were bent by striking an obstruction. On Oct. 28 a machinery trial was given the boat at New London. A speed trial was not undertaken till Nov. 22, when the starboard pump broke, and the trial was postponed till Dec. 1, when another attempt was made, resulting in breaking the low-pressure piston rod. Since spring the contractors have been putting the boat in readiness for her official speed trial, which the accident above recorded will probably delay for some time.

Steam-heated cars will be run on the Illinois Central's surburban trains next winter. As a result of tests of several steam-heating systems which the company made last winter, it has just given an order to the Safety Car Heating & Lighting Co., of New York city, for the equipment of 192 cars with a direct steam heating regulating system, in which by a special valve the amount of radiating surface in action can be increased or diminished according to the weather. This system was described and illustrated in our issue of Nov. 22, 1890.

A trunk sewer about five miles in length and 12 ft. in maximum diameter is to be built at Pittsburg, Pa., and bids will be received on July 27. A part of the sewer will be of brick, with an invert of Ligonier block stone. The sewer will drain 2,315 acres. Mr. E. M. Bigelow is director of public works.

The orders for steel rails received by the various rail mills during June are said to have aggregated 170,000 tons, which is a larger monthly total than has been recorded for some years past.

Molten iron is now carried five miles in ladle cars by the Cleveland Rolling Mill Co., from the central blast furnace to the steel works. About 15 minutes elapse from the filling of the ladles at the blast furnaces till the hot metal is in the mixer at the Bessemer plant. Eight trips are made each day, and about 500 tons of metal is tranferred in 24 hours.

An elevated wooden bicycle road, between Chicago and Milwaukee, is proposed by some capitalists of the latter city, and the Chicago "Herald" says that plans have been prepared and work will begin as soon as the right of way is secured. The capital of the company is $1,000,000, and the road would be 16 ft. wide and have termini in the business centers of the two cities. A toll of 10 cts. would be charged between the two cities, and its projectors confidently expect it to be used by 20,000 wheelmen per week. The length of the road would be about eighty-five miles.

About 700 tons of the nickel-steel armor-plate, made by the Bethlehem Iron Company for the Russian government, has been forwarded to St. Petersburg and accepted by the authorities. This is the first lot sent.

An apparatus for the removal of water weeds from the Park Lake of Buffalo is desired by the Park Commissioners of Buffalo. Plans and proposals for the construction of an efficient and economical machine will be examined by the commissioners if presented. Mr. Wm. McMillan is superintendent of parks.

A competitive race of road carriages operated by mechanical power is to be made between Chicago and Milwaukee, 85 miles, for prizes offered by the Chicago "Times-Herald." There will be four prizes of $2,000, $1,500, $1,000 and $500. This scheme has been suggested by the recent race of road carriages between Paris and Marseilles, in France, over a round trip of about 750 miles. The race will probably be run in November.

A road carriage competition for two or more prizes amounting to 1,000 guineas (about $5,250) is being arranged by the management of "The Engineer," of London. This paper has urged the repeal of the laws which prevent the use of light vehicles propelled by steam or other mechanical power on the public roads of Great Britain, and believes that this object can be attained and that British engineers and manufacturers should turn their attention toward the design and manufacture of road carriages before the French get too great a start in the field. Details of the competition are still to be announced, but the maximum weight allowed will probably be two tons.

A "raw-hide" cannon, invented by Frederick La Tulip, of Syracuse, N. Y., was tested at Sandy Hook on July 23, and successfully withstood a pressure of 30,369 lbs. per sq. in. This model gun was 5 ft. 8 ins. long, 2½ ins. caliber, and weighed 456 lbs. The bore is a steel cylinder, ¾ in. thick at the muzzle, and 2½ ins. at the breech. Over this is raw-hide, cut in 4-in. strips, and 1 in. thick at the muzzle and 3 ins. at the breech, and outside of this were two layers of heavy copper wire. The gun was a muzzle-loader, and in four successive shots, with varying charges, resisted pressures rising from 5,417 lbs. to 30,369 lbs. per sq. in. The carriage broke under the last shot, terminating the test. The only value in the gun seems to be in the reduction in weight as compared with steel.

THE CHICAGO SHIP BUILDING CO.'S NEW DRY DOCK.

The largest dry dock on the Great Lakes has recently been completed by the Chicago Ship Building Co., of Chicago, Ill., at their yards, on the Calumet River, between 100th and 102d Sts. This dock has the following general dimensions:

	Ft.	Ins.
Total length, face of crib to head of dock	475	8
Clear " inside of gate to head of dock	461	2
Width of body at top	100	0
" " " " floor	80	0
Depth of dock	20	6
" " water over keel block	16	0
" " " " sill	17	0
Width of entrance on sill	50	0
" " " 12 ft. above sill	70	0
" " " at top	70	0
Height of keel blocks	4	6

It will be seen that the dock is little inferior in size to many of the Government dry docks on the Atlantic coast, a list of which, with dimensions, was given in our issue of Dec. 20, 1894.

The location of the yards of the Chicago Ship Building Co. is about 1¼ miles from the mouth of the Calumet River, which enters into Lake Michigan at South Chicago, and along which are situated the slips and docks of the many manufacturing establishments of that busy section of the city of Chicago. This stream has a navigable length of about 25 miles, and for a distance of about 1½ miles from its mouth the United States Government has enlarged its channel to a width of from 200 ft. to 300 ft., and a depth of 17 ft.

As the dock was built over the site of one of the company's slips, it was decided to design it so that vessels could be launched into it. This use of the dock, of course,modified some of the dimensions and necessitated certain forms of construction which would not have been necessary had the structure been intended only for the purpose of docking vessels. One of these modifications, which will be noticed particularly, is the depth to which the vertical sides of the dock are extended below water before beginning the altars, so as to preclude any danger of the vessel striking the latter as she sinks in the water after leaving the ways. The launches of vessels into this dock are, of course, all side-on launches. In determining the proper shape and proportion of the side walls, the Designing Engineer, Mr. Ambrose V. Powell, investigated carefully the actions of vessels after striking the water from the launching ways, getting very valuable information in this connection by taking instantaneous photographs of several actual launches, and determining from them the angle which the vessel assumed as she sank.

As stated above, the dry dock was built on the site occupied by one of the company's slips, which was, of course, filled with water. This slip was 400 ft. long and 100 ft. wide, and had been dredged to a depth of 12 ft. below Chicago datum. The first step in beginning work was to make a series of borings to determine the character of the foundation bed. These borings were sunk to a depth of 63 ft., and were spaced about 50 ft. apart in the direction of the longitudinal axis of the dock, and 25 ft. apart in the direction at right angles thereto. The original surface of the ground on which the dock is located was 2½ ft. above Chicago datum (the height of low water, as determined by the engineers of the Illinois & Michigan Canal for the year 1847).

From the surface to a depth of about 16 ft. below datum the material was found to be a fine water-washed sand. Below this stratum came the ordinary Chicago clay, soft at the top, but gradually increasing in hardness below, until, at a depth of 37 ft. below Chicago datum, it became hard pan. The borings showed the character of the material to be uniform over the entire site of the dock.

After making the borings, the material was excavated by a dipper dredge to a depth of 25 ft. below datum, and the whole site was enclosed by a line of sheet-piling, as shown in the general plan, Fig. 1. This sheeting was driven at a distance of from 30 ft. to 40 ft. from the edge of the proposed dock, and consisted of 6-in. tongued and grooved piles, extending down well into the clay. The total length of the line of sheeting was about 1,400 ft., and the area enclosed about two acres. A cofferdam was built to close the entrance of the slip, as shown by Fig. 2. This cofferdam consisted of two parallel rows of 35-ft. piles, 16 ft. apart, the inside piles being driven 3 ft. apart c. to c., and the outside piles 6 ft. apart c. to c. The piles of each row were connected by wales, and a double row of 3-in. sheeting driven inside and outside. The two rows of piles were tied together with iron rods and the space filled with mud dredged from the bed of the river. As soon as the dam was completed the pit was pumped dry and the dam found to be without any leak. Fig. 3 shows the appearance of the pit after being pumped dry.

The character of the foundations is pretty clearly shown by the drawings in Fig. 1. Briefly described, the foundations consisted of piles driven to hardpan and spaced generaly 5 ft. apart c. to c.,

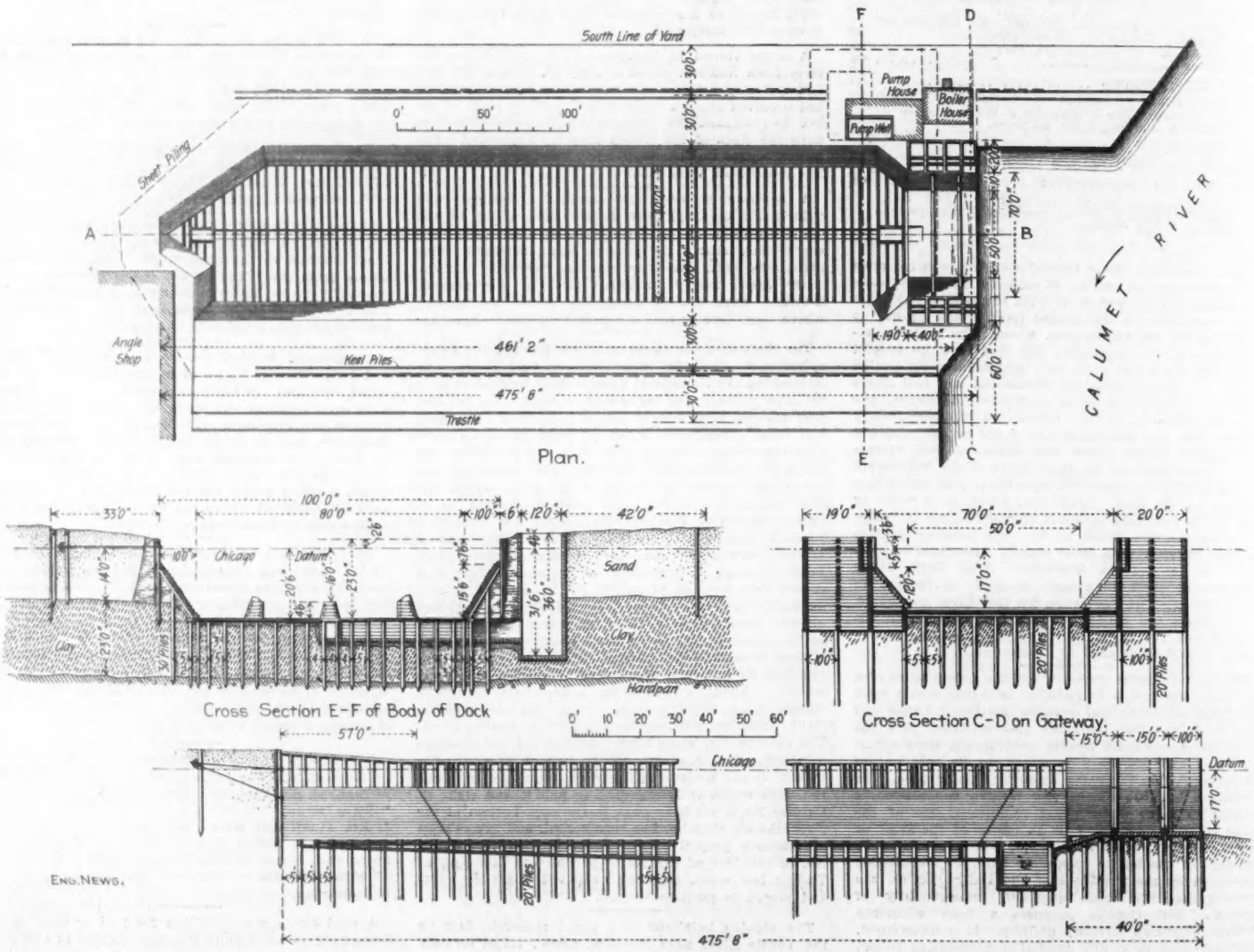


FIG 1. PLAN AND SECTIONS OF 460-FT. TIMBER DRY DOCK; Chicago Ship Building Co., Chicago, Ill.
Ambrose V. Powell, Designing Engineer; W. I. Babcock, M. Am. Soc. C. E., General Manager, Chicago Ship Building Co.

except along the keel line, where they were spaced 5 ft. apart c. to c. along the axis of the dock, and 2½ ft. apart, c. to c., at right angles thereto. The construction of the altars and flooring is clearly shown in Fig. 1 and also in Fig. 4, which is reproduced from a photograph taken during construction.

The construction of the entrance is shown in Fig. 1. As will be seen it has two sills spaced 15 ft. apart. This allows the inner sill to be docked in case of any accident by placing the caisson at the outer sill, and also allows the length of the dock to be increased 15 ft. if it becomes necessary. The inner sill will be the one generally used. The drawings also show the well and pump house placed at this end of the dock.

The dock is closed by a steel caisson, of the general form shown in Fig. 5. This view, of course, shows the caisson bottom upward, as it was constructed. The caisson is 72 ft. long, 13 ft. beam and 23 ft. deep, and is provided with nine 30-in. quick-acting valves for flooding the dock. With all the valves open the dock can be filled in 20 minutes. For draining the caisson a 6-in. steam jet pump is used.

In emptying the dock the water is taken to a pump well by means of a drain running longitudinally along the center of the dock, and connected with a transverse culvert, as shown in Fig. 1. This longitudinal drain is 5 ft. wide, and, commencing at the floor, near the inner end of the dock, gradually increases to a depth of 5 ft. at the culvert. The pump well is 12 × 26 ft., with its bottom 10 ft. below the bottom of the dock, and is constructed of 12 × 12-in. timbers. Two vertical centrifugal pumps, each with a 30-in. discharge, are used to empty the dock, and are capable of doing so in two hours. The pumps are placed at the bottom of the well, and are always submerged. They are driven by two vertical high-pressure engines, having 18 × 18-in. cylinders. Steam for the engines is supplied by four horizontal tubular 16-ft. × 60-in. boilers, using oil fuel. The pumps, engines and connections were built by the Southwark Foundry & Machine Co., Philadelphia. The power house contains, in addition to this pumping machinery, a high-speed Hammond engine, for running an electric light plant, and also the electric power plant for the sawmills connected with the ship yards.

The foregoing description, with the accompanying illustrations, will give a pretty complete idea of what is at present the largest dry dock on the Great Lakes. Work on the dock was begun April 2, 1894, the pit was pumped out on June 3, the dock was pumped for the first time with the gate in position Nov. 17, and the first vessel was docked Nov. 24, 1894.

FIG. 2. VIEW OF COFFERDAM ENCLOSING ENTRANCE TO SITE OF DRY DOCK.

FIG. 3. VIEW OF SLIP FORMING SITE OF DRY DOCK AFTER WATER WAS PUMPED OUT.

FIG. 4. VIEW OF DRY DOCK DURING CONSTRUCTION, SHOWING FOUNDATION WORK.

The Chicago Ship Building Co., which built the dock, was organized in 1890, and since that time has built some of the largest vessels on the Great Lakes. Among them may be mentioned the large passenger ship "Manitou" and the freight boats "Kearsarge," "Thomas Matham," and "Arthur Orr." There are now under way at the yards five steel ships, two steamers 400 ft. long, 48 ft. beam and 28 ft. molded depth, and three tow barges, two 320 ft. long each, and one 370 ft. long. The President of the company is Mr. Wm. L. Brown, of Chicago, and the Manager is Mr. W. I. Babcock, M. Am. Soc. M. E. Mr. Babcock is also a member of the Institution of Naval Architects of England, the U. S. Naval Institute and a number of other prominent naval engineering societies. Mr. Ambrose V. Powell, Consulting Engineer, Chamber of Commerce Building, Chicago, was the Designing and Constructing Engineer of the company's dry dock. We are indebted to Mr. Powell for the matter from which our illustrations and this description have been prepared.

METHODS OF MANUFACTURE OF PORTLAND CEMENT.*

The remains of great engineering and architectural works in Egypt and parts of Asia and Europe prove that ancient and extinct civilization was familiar with the use of cement. Mr. Henry Reid says: "These remains, of a varied and interesting character, even now show us how much of their stability and permanence is due to the quality of the cementing agents by which the building materials were put together."

The experiments conducted by Mr. John Smeaton in the years 1756 and 1757 for a reliable mortar for building the Eddystone lighthouse, and the experiments carried on by Dobbs, John, Vicat, St. Ledger, Paisley and Frost, in the early part of this century, and the taking out of patents by Joseph Aspin, of Leeds, England, in the year 1824 for the manufacture of what he called "Portland Cement," show that the men of the eighteenth century did not possess as much knowledge of hydraulic cement as the men of ancient times.

Mr. Aspin's Portland cement, so called because the artificial stone made from it resembled the Portland building stone of England, was manufactured under the following patent:

My method of making a cement or artificial stone for stuccoing, buildings, water-works, cisterns or any other purpose to which it may be applicable (and which I call Portland cement) is as follows: I take a specific quantity of limestone, such as that generally used for making or repairing roads, and I take it from the roads, after it is reduced to a puddle or powder, but if I cannot procure a sufficient quantity of the above from the roads, I obtain the limestone itself and I cause the puddle or powder, or the limestone, as the case may be, to be calcined. I then take a specific quantity of argillaceous earth or clay and mix them with water to a state approaching impalpability, either by manual labor or machinery. After this proceeding, I put the above mixture into a slip pan for evaporation, either by heat of the sun or by submitting it to the action of fire, or steam conveyed in flue pipes under, or near, the pan, until the water is entirely evaporated. Then I

* Condensed from a paper by Mr. Wm. G. Hartranft, read before the Master Builders' Exchange of Philadelphia.

break up said mixture into suitable lumps and calcine them into a furnace similar to a lime-kiln, until the carbonic acid is entirely expelled. The mixture so calcined is to be ground, beaten or rolled to a fine powder, and is then in a fit state for making cement or artificial stone. This powder is to be mixed with sufficient quantity of water to bring it into the consistency of mortar and thus applied to the purposes wanted.

Mr. David O. Saylor, the pioneer manufacturer of Portland cement in this country, said:

In order to make Portland cement, it requires a homogeneous mixture, containing in proper proportions carbonate of lime alumina, silica and iron. This mixture must be subjected to a heat sufficiently high to produce a vitrified, dense and heavy clinker, and afterwards ground to very fine powder. The induration or setting of Portland cement consists in the formation of a real mineral, of a crystalline rock species, which appears to be analogous to natural zeolites. This fact can be confirmed by microscopic examination of a true Portland cement. The set will be found to consist of translucent, and to some extent even of transparent, crystalline particles of different forms, exactly like those of the zeolites of nature.

At the present time the bulk of the English cement is manufactured from chalk instead of the hard limestone. This chalk is mixed with clay in the proper proportions in a large wash mill, and the slurry is then run off and dried, either by artificial means or sun evaporation. The only difference in the burning now from that in Aspin's time is that this dried slurry is now burnt to a hard clinker, instead of just expelling the carbonic acid gas.

Works were started for the manufacture of Portland cement in Germany, France and Belgium soon after the works were established in England. In the former countries it is largely made of an argillaceous limestone or a marl. This material is usually ground and mixed in a dry state, dampening only sufficient to mold into a brick, so as to facilitate the loading of the composition into the kilns.

The Portland cements of Europe did not begin to find their way to this country until about 1865. From 1865 to 1870 small quantities were shipped here and sold at from $8 to $10 per bbl. This large price and the increase in demand for this cement attracted the attention of Mr. David O. Saylor, who was then manufacturing, at Coplay, Pa., a light burnt, hydraulic cement, commonly known on this market as Rosendale, and he decided to make a Portland cement equal to any made in Europe, out of the argillaceous limestone found at Coplay, and which, in the latter part of the year 1874, he succeeded in doing. Although this was 50 years later than the industry was started in Europe, the American product at once took first place on large engineering works, where great quantities have been ever since used.

Gen. Q. A. Gilmore, after testing and inspecting the cements at the Centennial Exhibition, said there were 13 brands of foreign and one American Portland cement exhibited, and that the American brand stood among the five best specimens. In 1878 Capt. J. B. Eads selected an American Portland cement with which to build his great work, the Mississippi jetties, using 12,000 bbls. alone in this one operation. It is worth noting, while we are reading from time to time in the engineering journals of concrete work in Europe disintegrating under the influence of the salt and waves of the ocean, that these concrete jetties at the mouth of the Mississippi River, which have successfully withstood the action of the salt and waves of the Gulf of Mexico, are made of Portland cement, manufactured within 65 miles of Philadelphia.

American Portland cement was also used largely for the great concrete docks which the city of New York has been building for the past 18 years, on the big masonry dams and aqueducts of the Croton water supply for New York; in the foundations of the Brooklyn Bridge; in the Hudson River tunnel, and the Niagara tunnel; in the foundations of the new Manhattan Life Insurance Building, New York (20 stories high); in the new Capitol building, Albany, N. Y.; in the concrete jetties at Sandy Hook, and is now being used by the United States Government on the new Post Office building at Washington, D. C., and in the concrete sea walls being built at Brooklyn, League Island and Norfolk navy yards. Among the large buildings in Philadelphia built with American Portland cement are the Drexel Building, the Drexel Institute, Provident Building, Girard Building, Harrison Block, Pennsylvania R. R. station, Philadelphia & Reading R. R. station, Odd Fellows' Temple, Women's Medical College, Bourse Building and the new "Hotel Walton," the last two now under construction.

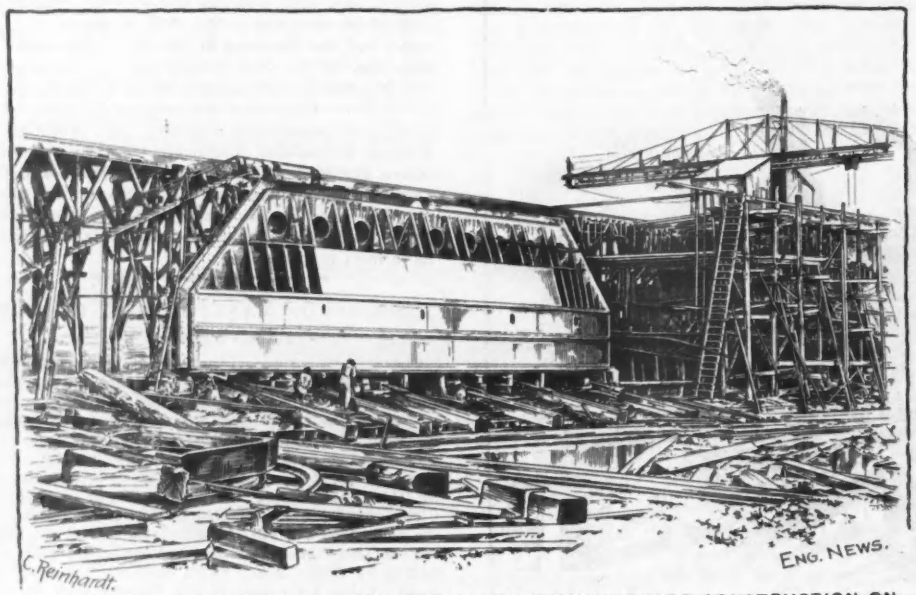


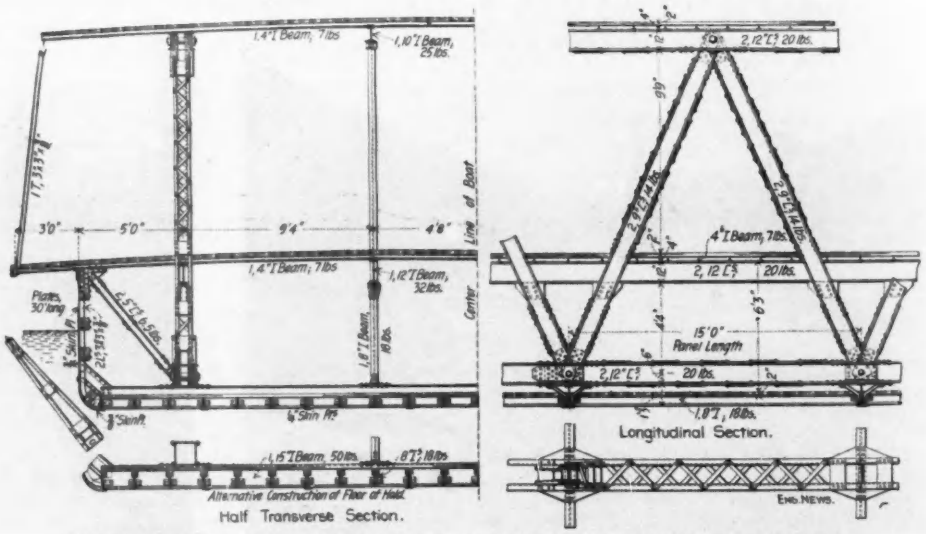
FIG. 5. VIEW OF STEEL CAISSON FOR CLOSING DOCK UNDER CONSTRUCTION ON LAUNCHING WAYS BESIDE DOCK.

Comparisons which have been carried out in a large and impartial manner have proven beyond question that the American Portland cements, as a class, are equal to the foreign cements. In proof of this, I will cite a few instances: In the report of the Engineer Commission of the District of Columbia for the year ending June 30, 1893, we find there were 7 German, 2 English and 5 American brands of Portland cement submitted for government work in Washington and carefully tested by the Commission. The two cements which proved to be the strongest, when tested neat and with sand mortar, and the finest ground, were both American Portland cements. In the report of the Water Commission of St. Louis for the year ending April, 1894, where 80,000 bbls. of Portland cement were recently used, we find tests on 15 brands of Portland cement, carried out for two years, and that among the four best brands was one made in this country. In the Annual Report of the Director of Public Works of Philadelphia for the year 1893 we find that two of the strongest and finest cements used were American brands. From over 6,000 tests made by the Survey Department of Philadelphia on cements being supplied for city work during the year 1894, we find that the average strength of the American Portland cements in neat and sand mortar was in excess of any of the foreign cements. The different foreign cements figuring in these various reports are the best European brands, many of which cost in this market from 25 to 50 cts. per bbl. more than the American Portlands.

In the year 1894 there were 19 Portland cement factories in the United States, with an output of about 700,000 bbls. of Portland cement, this amount being but 18% of what was imported. The largest factories are located in Lehigh county, Pa., in the neighborhood of Coplay. All the factories located in this region make cement under the dry process from an argillaceous limestone. There are several factories in New York, along the Erie Canal, and in Ohio, where marl and clay, or limestone and clay, are used. Practically nine-tenths of the Portland cement manufactured in this country is made in the states of Pennsylvania, New York and Ohio. Other states where small quantities are manufactured are Texas, Colorado, Dakota, Oregon, California and the territory of Utah. There is, however, plenty of raw material, suitable for making the highest grade of Portland cement, in almost every state in the Union.

A STEEL RIVER STEAMBOAT.

The flat-bottomed stern wheel steamers which are used on the Ohio River and its tributaries, and to a considerable extent all over the Mississippi and its tributaries, have always been built of wood. In construction, as many of our readers know, they are simple flat boxes stiffened by the great wooden trusses or hog chains running fore and aft. The use of steel has been frequently suggested for such vessels, especially since its price has been reduced to a figure at which it can compete with wood; but owners have hesitated to undertake the construction of such vessels, fearing that the proportioning of the parts of a steel frame to the strains upon them might not be successfully accomplished.



DESIGN FOR A FLAT-BOTTOM RIVER STEAMER OF STEEL CONSTRUCTION.

The problem has recently been taken up by the engineering department of the Carnegie Steel Co. and Mr. F. H. Kindl, Structural Engineer, has, in conjunction with Mr. Carl Schinke, worked out designs for a river steamer with steel frame and hull. The accompanying cuts show a half cross-section and partial longitudinal section of the vessel. Concerning this design Mr. Kindl writes us:

The experienced bridge builder will see that in this

design ue stresses for the different members can be readily and accurately determined; also, that the construction is of such simple character that it can come under the head of ordinary bridge work, with the exception of the plate work on sides and bottom. The members are made as nearly alike as possible, so that the detailing, as well as the chances of errors in making the drawings, are greatly reduced, as well as the expense of its manufacture; in fact, one panel is exactly the same as the other. The stresses can be figured, and have been figured for this case, as follows:

It is assumed that loads on the bottom of the vessel are directly counteracted by the water pressure. The total dead and live load has been taken at 200 lbs. per sq. ft. for the first deck, and 100 lbs. per sq. ft. for the second deck, thus causing a load of 17,000 lbs. and 19,000 lbs., respectively, for the first and second decks, to be carried by each post, or each strut of the truss, provided the entire barge is loaded to th's maximum. Each panel point will transmit to the 15-in. floor beams between two trusses a strain of 19,000 lbs. plus 19,000 lbs. plus 17,000 lbs., or a total of 55,000 lbs.

The maximum bending moment on the 15-in. beam is, therefore, readily determined and found to be 93,652 ft.-lbs., which gives a moment of resistance of 70.24 on an assumed fiber strain of 16,000 lbs. to the square inch; thus a 15-in., 50-lb. steel beam will be required.

Assuming that the boat is submerged 4 ft., there will be a side pressure on the vessel of 7,500 lbs. The bending moment created by this pressure is taken up by the side angle braces and transmitted to the 15-in. floor beams, and is counteracted by the moment received from the water pressure on the bottom. Taking now the stringers or longitudinal beams, which are 15 ft. long, and spaced 20 ins. c. to c., we find that, by calculation in the usual manner, an 8-in., 18-lb. beam is required, using again 16,000 lbs. fiber stress. The small 4-in. floor beams for the first and second decks are also readily determined in the same manner. The posts in the truss receive their maximum strain when the boat is fully loaded. Those posts carrying the concentrated loading, as engines, coal, boiler, rudder, etc., can be easily strengthened for this extra load. They have been designed of 9-in. channels, latticed. The top and bottom chords of the truss receive their maximum loads when the truss has to equalize concentrated loads. Assuming the concentrated loads for each truss to be 20 tons for coal and boilers, 10 tons for engine and stern wheel load, and the other loads uniformly distributed, and therefore taken up by the water pressure direct, we obtain a maximum stress in these chords by taking the bending moment 90 ft. from the coal and engine room, causing a stress of 240,000 lbs. Assuming a fiber stress of 20,000 lbs. for the channels, it is found that two 12-in., 20-lb. channels will answer this purpose. The small posts occurring throughout the barge, carrying the first and second decks, are, of course, also readily determined. In fact, there are no members in this design of river barge that cannot have their stresses thoroughly calculated, provided the load to be carried by the steamer, and its position, are previously fixed upon.

TRACK FOR HEAVY LOCOMOTIVES.

The comparative lightness of the track of many American railways which use very heavy locomotives has frequently been commented upon, both in regard to the danger of derailment and to the increased cost of maintenance. The conditions of safety and maintenance, however, vary according to the nature of the road and the traffic, as a light track which would be safe on straight and level line, where the trains run easily, might be dangerous and expensive on a line with sharp curves and steep grades over which the engines work very heavily. On the other hand, a well-laid and maintained track may give better service than a relatively heavier track with low joints, worn ties and loose ballast. In our issue of May 9 we gave the general dimensions of several of the enormously heavy engines now in service, and we have lately made some inquiry as to the tracks over which these engines are run. The principal relations of the engines and the tracks are given in the following table:

	Locomotive.								
Railway.	Type.	Total weight, lbs.	Wt. per driver, lbs.	Rail, lbs. per yd.	Joint.	Ties per rail.	Ballast.	Max. grade.	Max. curve.
Southern Pacific ...	12-wheel	173,500	18,313	76	.....	.....	.....	2.2%	10°
Dul. & Iron Range..	"	169,000	17,375	60, 80	24-in., 4-bolt	110 to 130 ins.	Gravel	....	...
Great Northern	"	156,000	17,000	80	36-in., 6-bolt	16 ties	Coarse grav.	....	...
Bur. & Mo. River ..	Decapod	150,300	15,030	56, 66, 75	4 and 6-bolt	18 "	Gravel&cin.	3.0%	10°
Cornwall & Leb....	Consolidation	150,000	16,875	60	4-bolt	16 "	Slag	1.7%	...
Del., Sus., & S....	Mogul	151,500	22,650	60	4-bolt	15 "	Cinders	....	...

Mr. R. Angst, Chief Engineer of the Duluth & Iron Range R. R., states that the twelve-wheel engines were too heavy for the original track, which consisted of 60-lb. rails spliced by 24-in. angle bars and four bolts, and having about 110 lin. ins. of tie face per 30-ft. rail. The bridges were built for 86-ton consolidation engines, with a train-load of 2,600 lbs. per ft. In 1888 renewals were begun, the amount of tie bearing was increased to 125 i.s. per rail, and the bridges were built for 100-ton consolidation engines, and 3,200 lbs. per ft. per train, while all new construction since 1891 has been based upon 120-ton engines and 3,600 lbs. per ft. of train. The ties are of swamp tamarack, except that oak ties are used on all curves of 4° and over, and the aggregate length of tie bearing is not less than 130 ins. per 30-ft. rail. The ties are hewed, 6 ins. thick, 7 to 10 ins. face, the joint and shoulder ties being selected as to width and thickness. The space between the joint ties is 3-5, and that between the joint and shoulder ties 4-5 of the average clear spacing of intermediate ties. Trials are being made with ties 7 ins. thick, and future specifications may call for ties 7 ins. thick, 8 to 11 ins. face and 8 ft. 6 ins. long. It is considered that ties 9 ft. long should be at least 8 ins. thick, and these are very hard to get. The above is for 60-lb. rails on new work, but on the old track 80-lb. rails of the Michigan Central R. R. section are used, spliced with 23-in. Samson angle-bars, and having home-made base plates at the joints. This joint we shall illustrate later. The ballast is gravel of various degrees of coarseness, with very little loam or clay, and is used very liberally. While there are twice as many consolidation engines with 103,000 lbs. on a driving-wheel base of 14 ft. 1 in. as there are twelve-wheel engines with 138,000 lbs. on a driving wheel base of 15 ft. 6 ins., there is a decided increase in wear and tear and in the number of low spots in the track, as well as much shortening of life in the bridges built before 1892 or since renewed, but the proportion of this increase due to the twelve-wheel engines cannot be estimated with any degree of certainty.

This road is rapidly reinforcing its bridges and is increasing the tie-bearing of the rails as fast as the track is renewed. Mr. Angst states that he is satisfied that in a short time the cost of maintenance with 80-lb. rails and twelve-wheel engines will not exceed that for the 60-lb. rails and consolidation engines, and he is not prepared to advocate a heavier rail for any purposes of economy. The preparation for an increased weight on driving wheels has led to a reduction in cost of maintenance with the lighter engines, and has enabled still heavier engines to be used with very little extra expense for reinforcing track and bridges. The effects of the heavier driving wheel loads of the twelve-wheel engines are apparently in a vertical direction, disturbing the surface of the track, as there is no noticeable increase in the nosing motion of the engines and incidental widening of the gage.

Mr. John F. Stevens, Chief Engineer of the Great Northern Ry., states that the heaviest engines in use on the mountain divisions are Brooks consolidation engines, weighing 156,000 lbs., with 132,000 lbs. on the driving wheels, and a tender weighing 86,000 lbs. The track on which these engines are run consists of 80-lb. rails, spliced with 36-in. angle bars weighing 30¼ lbs. each, and six bolts. There are 16 ties to a rail length, and the ballast is mainly of coarse gravel, with disintegrated granite in some cases, and this, packed very solidly, is as good as stone ballast. There is no special extra cost for maintenance where these heavy engines are used, and the track is considered amply strong for the traffic.

With regard to the heavy decapod engines used as pushers on the Burlington & Missouri River R. R., Mr. I. S. P. Weeks, Chief Engineer, states that the engines are used on track with 56, 66 and 75-lb. rails, with 18 ties to a rail length, and cinder or gravel ballast. The joints are spliced with four-bolt angle bars on the lighter rails, and six-bolt angle bars on the 75-lb. rails, the bars extend-over three ties. One of the engines was operated on the Newcastle & Cambria line, having 56-lb. steel rails on pine ties, 10° maximum curve, and 3% maximum grade, and caused no more apparent wear than a consolidation engine. When run at low speed, say 12 to 15 miles per hour, they are very easy on the track, and it is considered that at such speeds they can be run on less substantial track than is required for the Class H mogul engines (Eng. News, June 28 and July 5, 1890) at 45 to 60 miles per hour. No extra maintenance of track is required where these decapod engines are used.

Mr. John McDonell, Supervisor of the Cornwall & Lebanon R. R., states that the consolidation engines, weighing 150,000 lbs., in use on that road, run over a track consisting of 60-lb. Pennsylvania Steel Co. rails, spliced with four-bolt angle bars weighing 30 lbs. per pair, and laid on 16 white chestnut ties to a rail length. The ballast is furnace slag. There is one grade of 1.7% which is three miles long. The engines work very easily on the curves, and there has been no spreading of the track and no derailment of these heavy engines. The track is considered perfectly safe. It seems to us, however, that a 60-lb. rail with 16 ties per rail length is too light a track to be economical if used to any extent by engines with wheel loads as large as 16,875 lbs., and this opinion is confirmed by the experience of the Duluth & Iron Range R. R.

The Delaware, Susquehanna & Schuylkill R. R. has ten mogul engines weighing 151,500 lbs., with 135,900 lbs. on a driving-wheel base of 14 ft., the maximum axle load being 49,000 lbs. on the middle axle. The track over which these engines run consists of 60-lb. rails spliced by angle bars and four bolts, and carried by 15 ties to a rail length, the ties being protected by Servis tie-plates. The ballast is composed of cinders. This is the most severe service to which any of the tracks here mentioned are subjected, but Mr. Kudlich, Chief Engineer, states that with 1½ men per mile the track can be repaired and kept in perfect condition, the most trouble being at switches, of which there are 200 on 60 miles of track. The metal tie-plates are undoubtedly largely responsible for such a good record, and it may be that the traffic with these engines is not very heavy.

GOULBURN DAM, VICTORIA, AUSTRALIA.

(With Inset.)

In the rapid progress of irrigation enterprise in the Western United States, we are apt to forget that almost equally rapid progress is being made in this important department of engineering on other continents, and especially in the British colonies. Australia, with its large area of scanty rainfall, offers great opportunities for irrigation enterprise, and this work has been taken up by the colonial governments on an extensive scale.

A monograph on one of the most notable works of this class was published in 1893 under the title of the "Goulburn Weir and Its Dependent Works." The author, Mr. Stuart Murray, is Chief Engineer of the Victorian Water Supply Department, and was in charge of the work in question. Under Mr. Murray was Mr. Wm. Henderson, Assoc. M. Inst. C. E., as executive engineer in direct charge, and Mr. Maximilian Hector as resident engineer. Only a few copies of Mr. Murray's monograph were published, and we are indebted to Mr. Hector for his private copy of the work, from which we have taken the accompanying illustrations.

The Goulburn dam is built across the river of the same name, and is designed to raise the summer level of the stream 45 ft., or from 363 to 408 ft. above low-water mark at mean tide, in Hobson's Bay. Connected with the dam, as a part of the work being carried out directly by the government, are two canals, one on each side of the river, and an immense storage reservoir. In addition to the main works mentioned, which are constructed directly by the Victorian government, subsidiary distributing works are being carried out with money from government loans, but by local authorities, un-

der partial government supervision. The total area which can be irrigated from the reservoir and by gravity is about 775,000 acres, or a net area of 700,000 acres after allowing for roads and other reserves. The maximum carrying capacity of the two canals, as proposed, is 120,000 cu. ft. per min. In years of five months' full supply it is calculated that a total of 25,000,000,000 cu. ft. of water would be available for actual irrigation. With a total depth of 15 ins. of water applied during the season, this would irrigate 416,000 acres.

The Goulburn River is a tributary of the Murray, and above the dam has a drainage area of 3,940 sq. miles, of which about 3,600 may be called hilly, one-third of this being mountainous, with peaks attaining an altitude of 5,000 to 6,000 ft. The melting snows from these ranges maintain the river at a high level well into the summer. During the nine years, 1882-90, daily gagings of the river showed a minimum annual discharge at the rate of 18%, a maximum of 37% and an average of 29% of the total rainfall. This is said to be a high run-off for Australian rivers. The yearly rainfall in inches, the proportion of the same discharged by the river, and total annual discharge for the nine years were as follows:

Year.	Rainfall, ins.	Per cent. run-off.	Total discharge, cu. ft. (1 = 1,000,000.)
1882	30	32	86,812
1883	37	37	124,086
1884	29	19	50,963
1885	39	24	84,848
1886	40	18	67,029
1887	52	35	167,625
1888	32	27	80,061
1889	48	36	158,536
1890	42	33	128,563
Averages	39	29	105,391

The maximum known flood discharge of the river at about this point occurred in 1870, and is estimated to have been about 3,000,000 cu. ft. per min. For the nine years 1882-90 the least volume of the river was 2,500 cu. ft. per min. for a few days in April, 1882, and the greatest, 1,923,000, in November, 1887. The variation in the river flow for the period named was as follows, the figures being in cubic feet per minute:

Year.	Minimum.	Lowest monthly mean.	Maximum.
1882	2,500, Apr.	13,630, Mar.	631,000, Aug.
1883	27,000, Feb.	39,450, Feb.	1,291,250, "
1884	36,000, Apr.	44,950, Apr.	331,850, "
1885	20,000, Mar.	31,500, Mar.	1,155,750, Sept.
1886	23,500, Apr.	33,550, Apr.	610,160, Aug.
1887	27,000, Feb.	33,880, Feb.	1,923,330, Nov.
1888	36,000, Apr.	46,350, Apr.	590,000, July.
1889	18,300, Mar.	22,670, Mar.	1,815,000, Sept.
1890	23,500, Mar.	28,740, Mar.	769,590, Oct.

During the four years the dam was under construction the greatest rise in the river in 24 hours was 10 ft., and the greatest fall, 8 ft.

The gagings were made by the aid of a profile of the river bed, a fixed gage staff and a current meter, Mr. Murray's description of the work being as follows:

> The method employed for measuring sub-surface velocities is that described in Revy's "Hydraulics of Great Rivers." The instrument, Revy's pattern, is allowed to record for about three minutes at each immersion, the exact time being noted by a chronograph.
>
> The mean velocity in each vertical is computed from a diagram constructed by plotting a curve of velocities from surface to bottom of stream, and dividing the area of the figure contained between the vertical and its corresponding curve by the depth of water at that vertical. With these mean velocities in verticals, as ordinates to a horizontal line representing the water level, a curve of mean velocities is plotted on a diagram of the cross-section of the river, for each gaging. The discharge is then computed by multiplying each portion of the area of the cross-section contained between adjacent verticals, in which velocities are measured, by the mean ordinate for that area, and adding the products. Finally, a curve of discharges, the abscissas and ordinates of which represent the corresponding areas of waterway and volumes of discharge, respectively, at each stage of the stream at which gagings were taken, is plotted; and a table showing the discharge at every inch on the gage is compiled therefrom. By applying to the daily gage readings the volumes of discharge thus computed the daily discharges of the stream are arrived at and entered in the tables. From these the maximum, minimum and mean discharges per minute for each month are compiled for publication.

A contract for constructing the dam was awarded in April, 1887, to Cornwell, Darling & Co., who at once began work. The structure was completed in December, 1891. A plan of the dam is shown on the inset, Fig. 1, and a section by Fig. 2. A view of the completed structure is shown by Fig. 7, in the text, and Fig. 8, also in the text, shows a part of the dam during a flood in July, 1891, when 1,453,000 cu. ft. of water per minute was passing over it. The dam rests on rock of the Upper Silurian formation, consisting of alternating and almost vertical beds of sandstone, slate and pipe clay, extending diagonally across the river. The dam raises the summer level of the river 50 ft. Its length is 695 ft., not including 230 ft. taken up by the channel regulators, or head gates for the eastern and western canals. It is composed of bonded concrete blocks, backed with stepped granite, Fig. 9 in the text, in blocks of the same height as those in the concrete, each granite course being notched into that next below. In that portion of the dam which extends across the old river channel are six tunnels, each with a sectional area of 44 sq. ft. These were used to carry the ordinary river flow during construction. The masonry enclosing these tunnels was built with the aid of cofferdams, a section with two tunnels being built on one side of the channel, then on the other while the first two were in use. When the four outer tunnels were in service the third cofferdam and two central tunnels were constructed. The tunnels were permanently closed with cast iron gates at the completion of the dam. Several times during construction the dam was overtopped by floods, but no particular damage was done.

The foundations were carried into the rock and bonded to it by two longitudinal trenches in the softer and one in the harder material. When these trenches encountered sufficiently firm material, the vein of the latter was not excavated. Along the toe of the dam a trench was cut into sound rock for the footing of the masonry. All the excavation was done by hand without blasting.

The location and construction of the tunnels and tunnel gates is shown by Figs. 1 to 4, on the inset. The combined cross-section of the six tunnels is 264 sq. ft., and they were calculated to discharge 225,000 cu. ft. per min. under 10½ ft. head. The tunnels are lined and faced with granite. The tunnel sluice gearing was intended for use only during construction, and for permanently closing the gates after the dam was completed.

FIG. 7. VIEW OF GOULBURN DAM FROM EAST BANK.

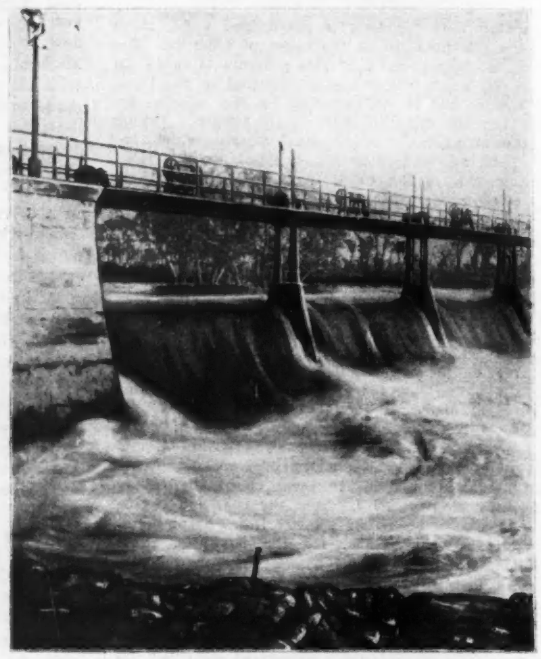


FIG. 8. PARTIAL VIEW OF GOULBURN DAM FROM EAST BANK DURING FLOOD OF JULY, 1891, WHEN PASSING 1,423,000 CU. FT. PER MINUTE.

It was thought possible, however, that after the gates were shut, leaks might develop, and it might become necessary to draw off the water again to repair them. On this account temporary platforms and connections for opening were provided for three of the gates, as shown in the sectional views.

The construction of the flood gates and chambers is shown by Figs. 2, 3, 4 and 6, on the inset. There are 21 gates, each 20 ft. 11 ins. wide and 10¼ ft. high, giving a waterway 20 ft. wide and 10 ft. high in the clear, up to the regulated level of the river. They are worked by three 30½-in. Leffel turbines, and are regulated from day to day so as to maintain the water surface at a constant level. Mr. Murray writes us that from the end of July, 1891, when the river surface was brought to the full supply level of the offtake channels, to the date of his letter, the water had been maintained at this level within a variation of less than 2 ins.

The gate chambers have gun metal faces at the upstream side, to close with the gate faces. At three points in the downstream lip brass blocks are bolted to the framework to bring the closing faces together in case of any flexure of the gates. The bolts and stay-bars designed to tie the framework of the chambers to the masonry are shown in Figs. 2 and 6.

The gates are of iron T-beams, filled between with cast iron plates, and having box-shaped cast iron ends. The sectional area of the flanges is 7 sq.

ins.; the webs are ¾ ins. thick, 13 ins. deep at the center and curved to 8½ at the ends. At the center the gates are stiffened, as shown in Fig. 2, by a lattice-work of forged, wrought iron bars. Additional stiffness is given by "pipe-stay distance pieces, secured by long bolts passing through the webs of the beams between the lines of lattice-work." The hanging shafts at each end of the gates are of forged iron, 2½ ins. in diameter within the boxes, swelled to 4 ins. with collars connecting them with the lifting screws.

The gate piers are of cast iron, filled with concrete, 10½ ft. wide at the base, 4¾ at the top, and, exclusive of flanges, occupying 2 ft. of waterway at the working faces. They are fitted with brass facing strips. The iron is 1 in. thick in the body of the piers and 1⅛ in the flanges.

The gearing for the flood-gates is carried on the bridging above, and is arranged for both hand and hydraulic power. The three 30½-in. Leffel turbines have two sets of buckets, one above the other, discharging centrally and downwards, respectively. The inlet sluices are provided with cast iron gates, movable brass gratings and gun metal lifting screws, supported by collars and wall brackets.

Two of the turbines are placed at the angle near the western end, and the other is located near the eastern end of the dam. An elevation and section of one of the turbines, turbine wells and accessories is shown by Fig. 5.

The gates weigh seven tons each. In lowering, the friction due to the water pressure is so great that the gates have to be forced down an average distance of 4½ ft. The turbines are stated to give from 3 to 27 HP. for heads of 3 to 13 ft., the revolutions varying from 78 to 163 for these varying conditions. The maximum load per gate is about 36,400 lbs.

Five 2,000-c. p. Brush electric lamps are provided for convenience in night work in manipulating the gates or steering drift wood. The dynamo for these lamps is driven by a 23-in. Leffel turbine.

The cement called for in the specifications was best Portland of not less than 112 lbs. weight per Imperial struck bushel (108.5 lbs. per U. S. bushel, assuming 1 Imp. bu. = 1.032 U. S. bu.), and of such fineness that in passing through a sieve of 2,500 meshes per sq. in. not more than 17½% of its volume would be lost. Briquettes seven days old were required to stand a tensile strain of 300 lbs. per sq. in.

The stone used for concrete was chiefly the hardest and cleanest portions of a sandstone rock quarried some two miles away. It was freed from all weather-beaten or clay-covered faces, and was then broken in a crusher and screened free from dust. It was intended to make the concrete of about one-third part of clean gravel or water-worn shingle, but this could not be easily procured, as it required much washing to free it from clayey matter, and such of the concrete as contained it proved to be of inferior strength.

The concrete used was composed of 1 part of cement, 2 parts sand, and 4½ parts of broken stone, or of stone and the shingle mentioned, the stone having 2½ ins. for its greatest dimension. For some special work a richer concrete was used.

The granite was all carted 15 miles over roads which were frequently very bad.

The leading items in the whole structure, including the headworks, not yet described, were as follows:

Excavation	120,539	cu. yds.
Granite masonry, coursed	76,016	" ft.
Cement concrete	15,276	" yds.
Pitching and rubble	671	" "
Timber	1,839	" ft.
Cast iron	442	tons.
Wrought iron and steel	175	"
Gun metal and brass	23,474	lbs.

The face of the concrete was plastered with a thick coat of 1 to 1 Portland cement mortar, and the gate chambers and turbine wells with ¾ ins. of such mortar in two coats. Before applying the mortar the concrete was hacked and wetted.

The headworks for each channel are set between cast iron piers and worked by shafts from the gangway by worm gearing. The gates are 7 ft. high and 10 ft. wide, formed first of six horizontal wrought iron H-beams, 7 ins. deep and 3½ ins. between flanges spaced to correspond approximately with the pressure; next there is a vertical, central H-beam built of 8½ × ¾-in. flanges, 4 × 3½ × ½-in. angles and ½-in. webs, riveted. The space between the beams is filled with 1⅞-in. tongued and grooved elm plank.

Careful surveys of the river bed for a distance of 53 ft. below the toe of the dam, made in April, 1892, and February, 1893, showed a gradual wearing down of the elevations and filling of the depressions in the bed. It was subsequently determined to fill in the hollows for 50 ft. below the dam, and to fill in with a flat slope the space between the bottom of the tunnel sluices and the river bed. This latter work has already begun, using hard waste material from the original excavation, and protecting the surface with cement concrete.

The tunnel sluices may eventually be filled in with concrete, as they are not likely to be needed, and after a few years the corrosion of the gates and the accumulation of silt behind them would probably make their opening impossible anyway.

As stated above, the water surface has been maintained at a constant level, within 2 ins., since the reservoir was filled. It is proposed to continue it at this level so long as the capacity of the completely lowered gates, 1,857,000 cu. ft. per min., is not exceeded. Should a flood like that of 1870 occur, about 3,000,000 cu. ft. per min. would pass over the dam, submerging the gateheads by 61 ins. when closed, and reaching within 23 ins. of the top of the bridge girders.

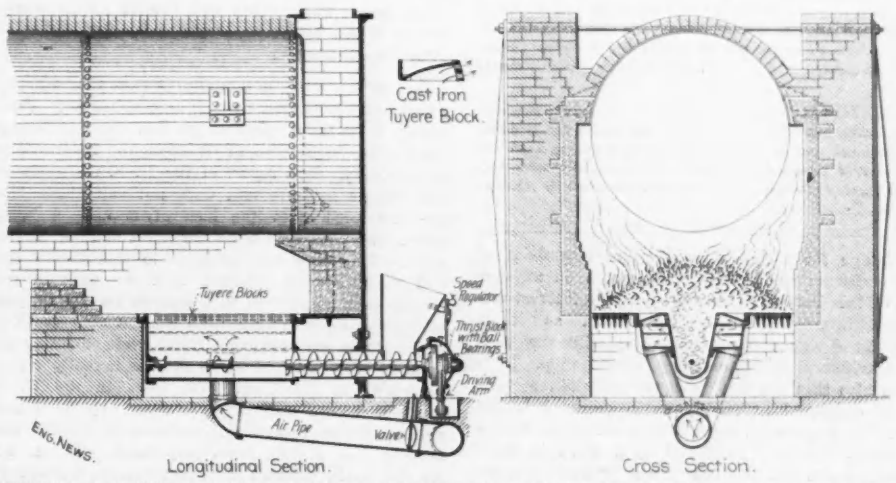
In manipulating the gates, one turbine can raise one gate through the entire 10 ft. in about 6⅔ minutes, or two gates at once in about 8⅓ minutes. One gate can be lowered in 5½ or two in 6 minutes. Working the gates one by one the 21 can be raised in about 3½ and lowered in about 3 hours. In less than 1 hour the gates can be raised to meet the greatest recorded 24-hour increase in the volume of the river. The hand winches, already referred to, are provided for raising or lowering the gates through the last inch or two to prevent shock of contact, and for use in case of emergency.

The total cost of the dam, including everything but land, was approximately $500,000. Land bought for the weir cost nearly as much more. Up to the time of writing the monograph from which this information is taken, the total expenditures for the dam and dependent works, including land purchased and 19½ miles of the western or largest proposed canal, amounted to over $2,000,000. This includes nothing toward the cost of the eastern channel or for the Waranga reservoir, and no parts of the cost of the work done by the trusts which will receive and distribute the water provided by the Goulburn works.

Up to Dec. 21, 1893, Mr. Maximilian Hector, Engineer of the Rodney Trust, informs us there had been constructed 95 miles of main and 185 miles of secondary channels for stock, domestic and irrigation purposes, and yet the work was only half done in the Rodney Trust. The trust area is nearly 300,000 acres, and irrigable land sells, he states, for from $40 to $120 an acre.

THE AMERICAN UNDER-FEED MECHANICAL STOKER.

We illustrate herewith a mechanical stoker which has recently been used with satisfactory results in a number of large steam power plants in the cities of Dayton and Cincinnati, Ohio. It is called the American underfeed mechanical stoker, and the two sectional views show its construction and operation quite clearly. The fuel is conveyed from the bottom of the hopper to the combustion chamber by means of a screw conveyor operated by a ratchet wheel and pawl driven by a shaft extending in front of the boilers, and actuated by a small engine. This screw feeds directly into a V-shaped chamber which has along each side at the top a series of tuyeres through which the air for combustion is furnished. As will be seen, the idea is to have the gases from the green fuel at the bottom pass up through the incandescent coke, where it is mixed with the necessary air for combustion. The rate at which the fuel is fed can be varied from 25 lbs. to 1,500 lbs. per hour. The air is supplied by a blower operated by the small engine which operates the screw conveyors. It is claimed that the cost of maintenance will be very small, practically being limited to the renewal of the cast iron tuyere blocks.



AMERICAN UNDERFEED MECHANICAL STOKER AS APPLIED TO RETURN TUBULAR BOILER.

Very few exact figures can be obtained as to the efficiency of this stoker owing to its being only recently put on the market. The manufacturers claim an actual saving of 26% in fuel during a six month's test with four boilers of the Stoddard Mfg. Co.'s plant at Dayton, O. The stokers are also being used in the "Cincinnati Commercial Gazette" company's power plant, and have given very satisfactory results in smoke prevention and fuel economy according to recent issues of that paper. The stoker is manufactured by the American Stoker Co., of Dayton, O., and we are indebted to this firm for the matter from which the accompanying illustrations are prepared. For the benefit of those who may wish to compare this stoker with other well-known American stokers we refer to the article in our issue of Aug. 9, 1894.

Coal production in the United States for 1894, says the U. S. Geological Survey, amounted to 170,853,085 tons of 2,000 lbs., for all sorts of coal. The total valuation was $186,154,604. As compared with the product of 1893, this shows a decrease of about 6% in amount and a little more than 10% in value. The general average price received for bituminous coal at the mines declined from 96 cts. per ton, in 1893, to 91 cts. in 1894. Anthracite coal declined from $1.59 to $1.51 per ton; and the general average for all coal declined from $1.14 to $1.09. The total of Pennsylvania anthracite mined in 1894 was 51,921,121 tons, as compared with 53,967,543 tons in 1893. The total bituminous was 118,931,964 tons in 1894, as compared with 128,385,231 tons in 1893.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 20. Rates for standing advertisements sent on request. Changes of standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

A design for a flat-bottomed river steamboat of steel construction throughout is shown on another page of this issue, and should especially interest our readers interested in bridge works, as it is especially designed for construction with the tools and machinery of an ordinary bridge shop. It is shown also that the strains in the various members can be computed as readily as in ordinary bridge work. Just at present, we believe, most of the bridge companies are fully employed upon work in their ordinary lines; but the hint given by the Carnegie Steel Co. should not be lost sight of by bridge works located on our Western rivers when the next slack season comes.

In connection with the reports of the operation of the great Niagara Falls power plant, and of the entire success of all the apparatus, both hydraulic and electrical, it is interesting to note the fact that notwithstanding the enormous amount of advertising that has been given the project, with the view of inducing manufacturers to locate near Niagara and utilize its cheap power, there have as yet only two contracts been entered into for electrical power; one for 2,000 and one for 1,000 HP. At this rate it will be a long time before the 100,000 HP. available will be utilized. Cheap power is not the only thing necessary to build up a great manufacturing center. Nearness to market, convenience of obtaining a plentiful supply of skilled workmen, nearness of raw material, etc., are some of the other elements of the problem. New York city, Brooklyn and Chicago cannot be said to have very cheap power, yet manufacturing seems to grow in these cities faster than almost anywhere else in the United States. In computing the value of water-power, moreover, we are inclined to think that recent estimaters are apt to overrate the cost of steam power. We notice that the Scranton, Pa., Board of Trade is carrying a standing advertisement in one of our contemporaries, to the effect that steam power can be generated at a cost of but $4 per HP. per year at Scranton. Probably some allowance should be made for the influence of local enthusiasm in making up this figure, but it is at least of interest as some indication of the possibilities of cheap steam power at the present day.

A correspondent in another column takes us to task for our note in our issue of July 11, in which we expressed approval of the veto of the Illinois water-way bill, recently passed by the Illinois legislature, and some statements in his letter call for an explicit reply. In the first place, we must deny that any personal reflections or insinuations whatever were intended by our editorial note. We had at the time no knowledge of the interests back of the bill, nor of the names proposed for the office created by it. Our suggestion that the bill was pushed for unworthy reasons was made simply because we could not believe that those responsible for the bill could actually consider it for the public interest. We have since been assured from sources entirely trustworthy that the bill was drawn and pushed in good faith, and, this being the case, we are glad to withdraw this portion of our criticism.

Next, as to the merits of the bill itself, our correspondent's defense of it fails to convince us that it was meritorious. We do not consider that either the Chicago Board of Trade, the Illinois legislature or the voters along the Illinois River are likely to judge in a broad and impartial manner of the merits and demerits of such a scheme as this. Local commercial and legislative bodies are always prone to believe that the public interests urgently demand that the United States should spend large sums of money in their immediate localities. If Congress were to respond to every appeal from local bodies for public buildings, river and harbor work, army posts, navy yards and similar public works, Uncle Sam's pocketbook would be far worse off even than it is now.

Let us see what it actually is that this bill proposed, as interpreted by our correspondent. Practically it is for a state to go into the business of influencing legislation at Washington favorable to its interests. The report of the U. S. engineers on the Illinois improvement does not suit those who are enamored with the idea of making a "deep water-way" between Lake Michigan and the Mississippi. Therefore they propose to establish a special State Bureau charged with the duty of collecting data to present to Congress for the purpose of influencing it to undertake work which the U. S. engineers do not approve. Now, while this may not seem so very criminal on its face, is it really a good precedent to establish? We have in the U. S. engineer corps a body of professional experts of high ability, whose record for unswerving fidelity and honesty has seldom been impugned. Is it not for the public interest to have Congress advised by such a body of experts, who are free from the narrowing influence of local prejudice, rather than influenced by any state appointees, who would natusally work for the interests of their state alone, regardless of the effect on other interests.

To give a concrete illustration: our correspondent proposes to remove all locks and draws from the lower Illinois River, and would maintain a sufficient depth for boating by "an adequate supply of water from Lake Michigan." But the very question, What amount of water can be spared from Lake Michigan without materially affecting the levels of the Lakes? is one on which we can hardly take a final answer either from the local interests at Buffalo and other parts of the lower lakes or from Chicago and the Illinois Valley. It is better for all parties concerned that this question should be handled by the non-partisan body of experts which is now considering it.

It must not be forgotten that neither the state of Illinois nor any other state has any control of the navigable waterways within its borders, except such as are entirely artificial. No state can undertake to improve or alter its rivers or harbors at its own expense, except by consent of the National Government. The proposed Illinois Commissioner of Waterways, therefore, would have no power to inaugurate work; he could simply appeal to Congress to do this or that, as any other private citizen may do. His work, so far as he performed it, would fall entirely within the duties of the U. S. engineers, and such duplication of work—such interference between state and national officials—is certainly unwise.

Our correspondent, in some inscrutable manner, extracts from our note the idea that we object to high salaries for engineers. We beg to assure him that he is entirely mistaken on this point. Our comments on this point were based, as we have stated above, on what we now believe to be a mistaken impression of the motives behind the bill. We are always pleased to see an engineer receiving a just reward for his labor; but, on the other hand, we object to having places which should be filled by engineers turned over to political workers.

As to the feasibility and advisability of the proposed deep waterway from Chicago to the Mississippi, let us lay down first the general principle that it is contrary to the public interest for any engineering work to be undertaken which will not in the long run pay a fair return upon the money expended in it. Whether or not the proposed Illinois River improvement is such a work, we will not now take space to discuss. In general, however, we believe that the advocates of deep waterways and ship canals have not a due appreciation of the enhanced cost of moving water traffic in a narrow channel, as compared with open water, or of the very low cost at which bulk freight can be handled on a well-located railway with modern heavy locomotives and large-capacity cars.

The proposed building of an elevated bicycle road between Chicago and Milwaukee, a distance of about 85 miles, is an indication of the importance the "wheel" is assuming as a means of transport. In many localities it is already interfering with the income of trolley suburban lines almost as much as these lines have affected the traffic on steam railways. In our large cities special streets are now set apart for bicyclers, and a suitable smooth roadway is provided; in other cases petitions are being actively circulated, asking that such facilities be provided. The wheel, in fact, has superseded horses in great part, and the speed obtainable makes it a formidable rival to electric or other mechanical means of transport over considerable distances. We are not prepared to state how many bicycles are now used by the men of New York city and vicinity in reaching their places of business, but it is safe to say that large as the number is, it would be vastly increased were a smooth, direct and unobstructed roadway provided especially for this class of travelers. There should be a round profit in an elevated bicycle road, extending from beyond the Harlem to the Battery in New York, for the enterprising capitalists who first secure the right to build it. It would be a cheap road to construct, for the maximum load would be very light on an 8-ft. or 10-ft. wide structure carried on posts on each side of a street. And it would be the last objectionable of all roadways in operation, for there would literally be no noise and no dirt; and as the wear upon its road surface from pneumatic tires would be inappreciable, the cost of maintenance would be equally light. A few toll-collectors and bicycle stable-masters at intervals along the line would constitute the entire working force. A central route through the city should not be difficult to secure under these circumstances, and when to the number who would use it for business purposes is added the increasing number who would seek this pleasant route for exercise and pleasure, the business of the toll-collectors and the dividends of owners should be equally increased. It would seem to be a scheme worth materializing.

THE ELASTIC LIMIT AND THE YIELD-POINT.

The extended correspondence of Mr. Cunningham, Mr. Webster and Mr. Cooper on "The Meaning of the Elastic Limit in Steel Specifications," in our issues of April 18 and 25 and July 4, and the letter of Mr. Henning in this issue, in which he uses the modern term "yield-point," and distinguishes it from the elastic limit, reopen the discussion of a subject of vital importance to those interested in questions relating to the strength of iron and steel, whether as manufacturers, users, testing and inspecting engineers, or framers of specifications. The confusion of the definitions of the terms elastic limit and yield-point as given by different writers, and the changes that have gradually taken place in methods of testing and of measurement since the introduction of power-driven testing machines, render it advisable

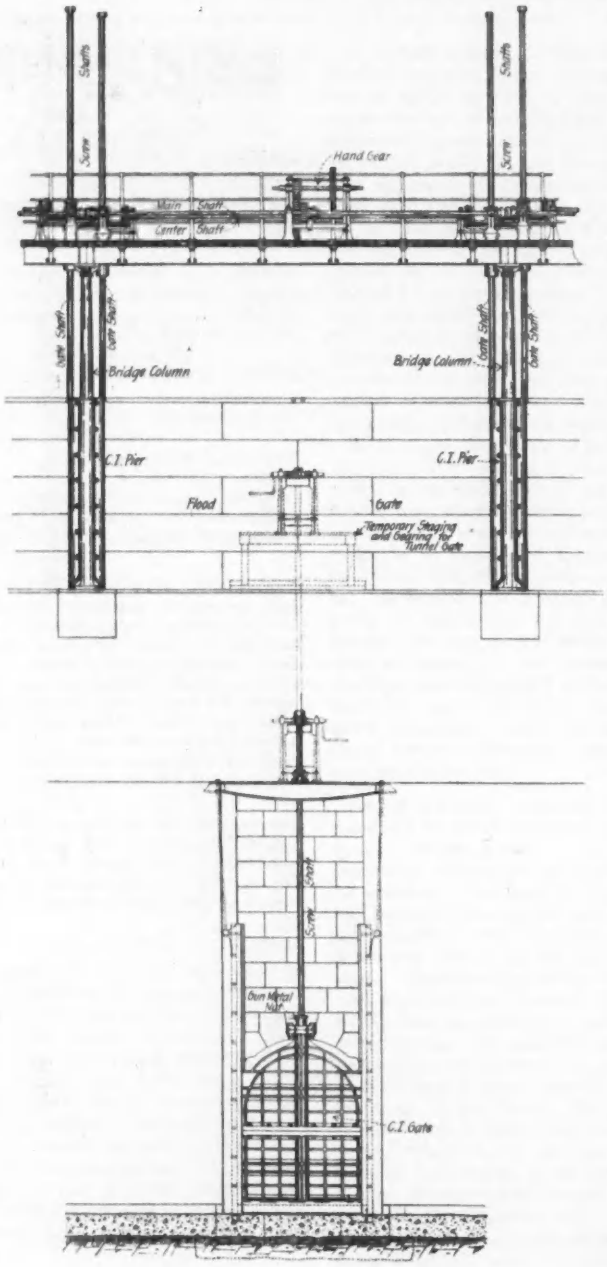


FIG. 3. UP STREAM ELEVATION OF TUNNEL AND FLOOD GATE.

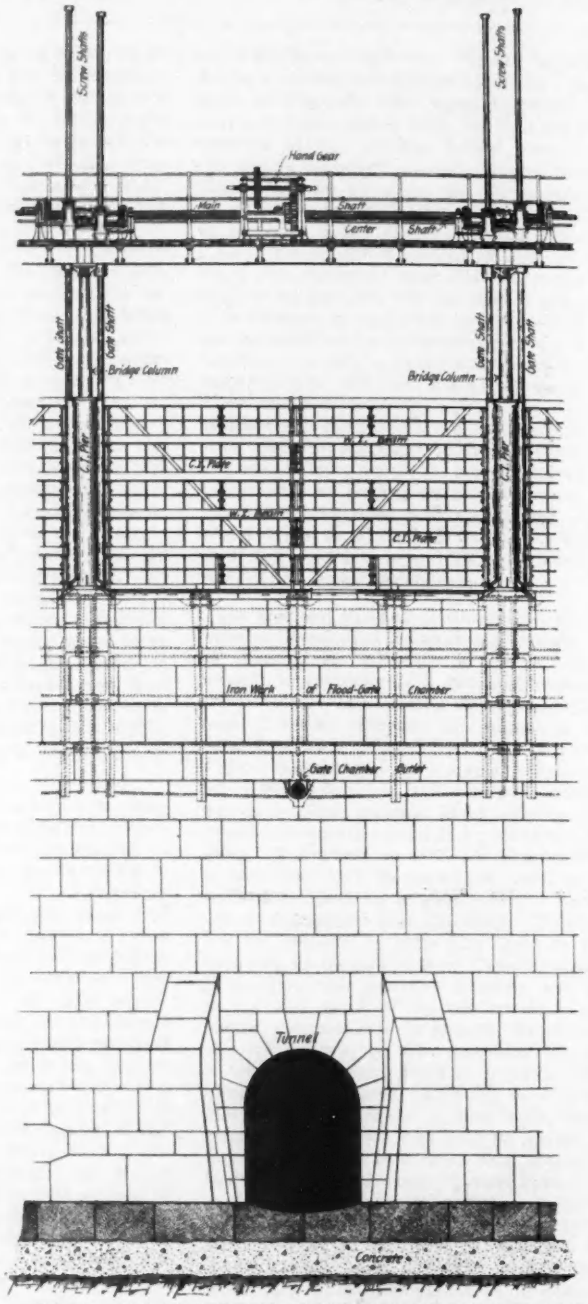


FIG. 4. DOWN STREAM ELEVATION OF TUNNEL AND FLOOD GATE.

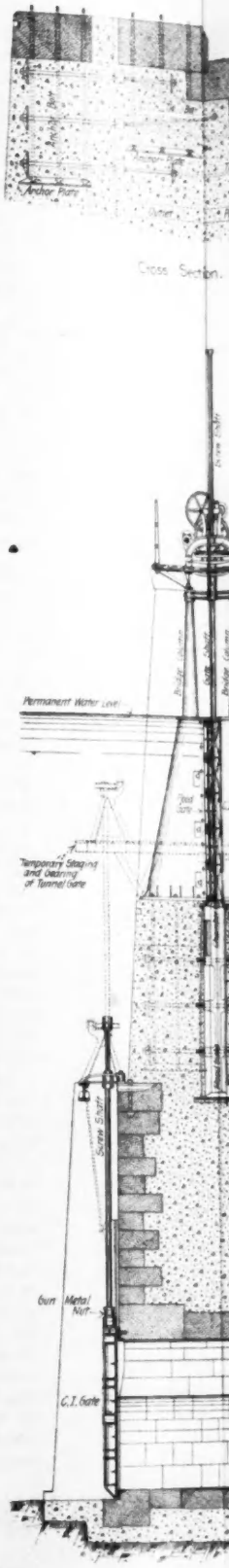


FIG. 2. C

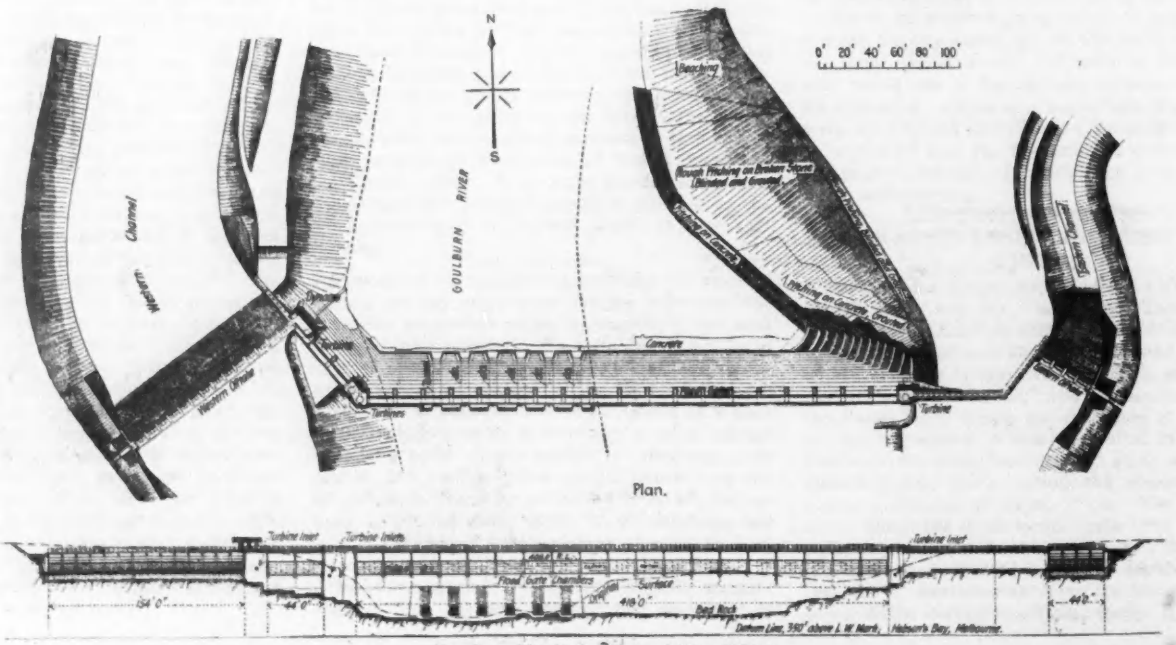
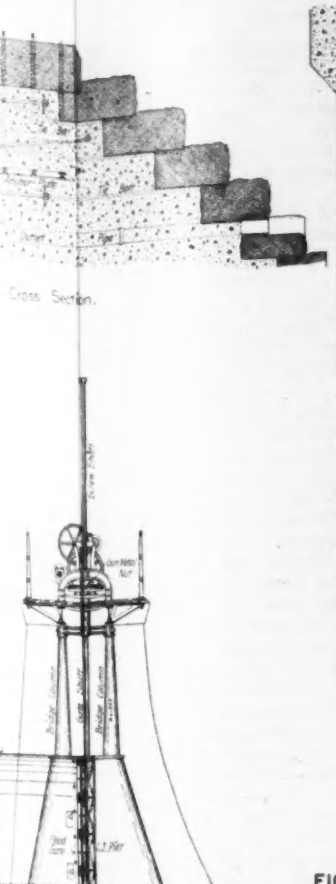
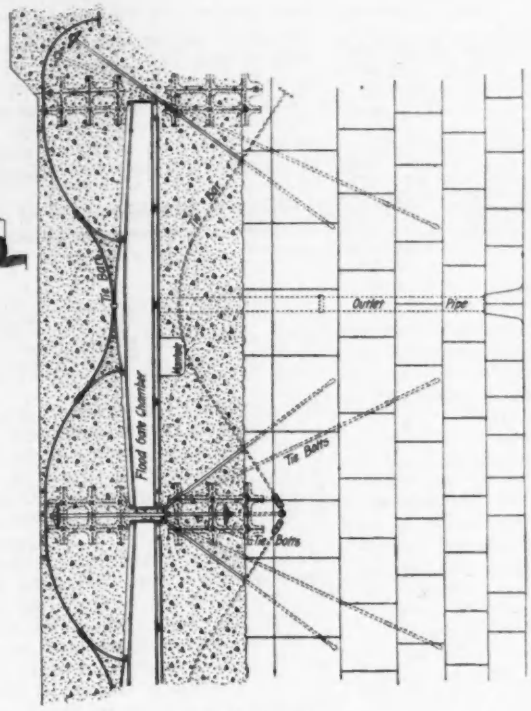


FIG. 1. PLAN AND ELEVATION OF DAM AND OFFTAKES.





0' 1' 2' 3' 4' 5' 6' 7' 8' 9' 10'

FIG. 6. TIE RODS AND BARS ABOUT FLOOD GATE CHAMBERS.

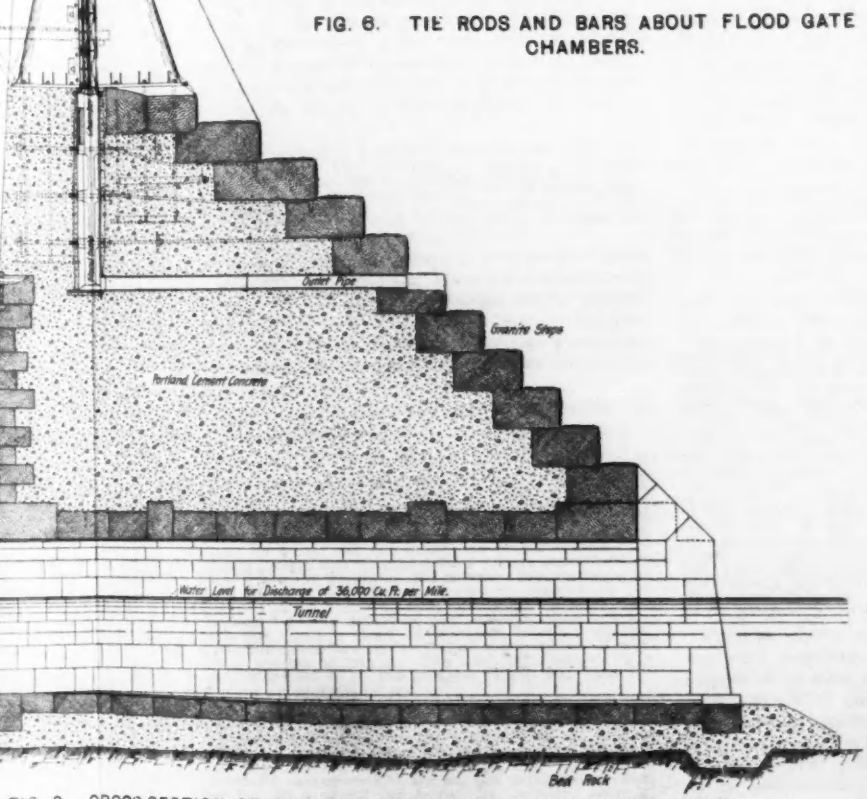


FIG. 2. CROSS-SECTION OF DAM THROUGH TUNNEL AND FLOOD GATE.

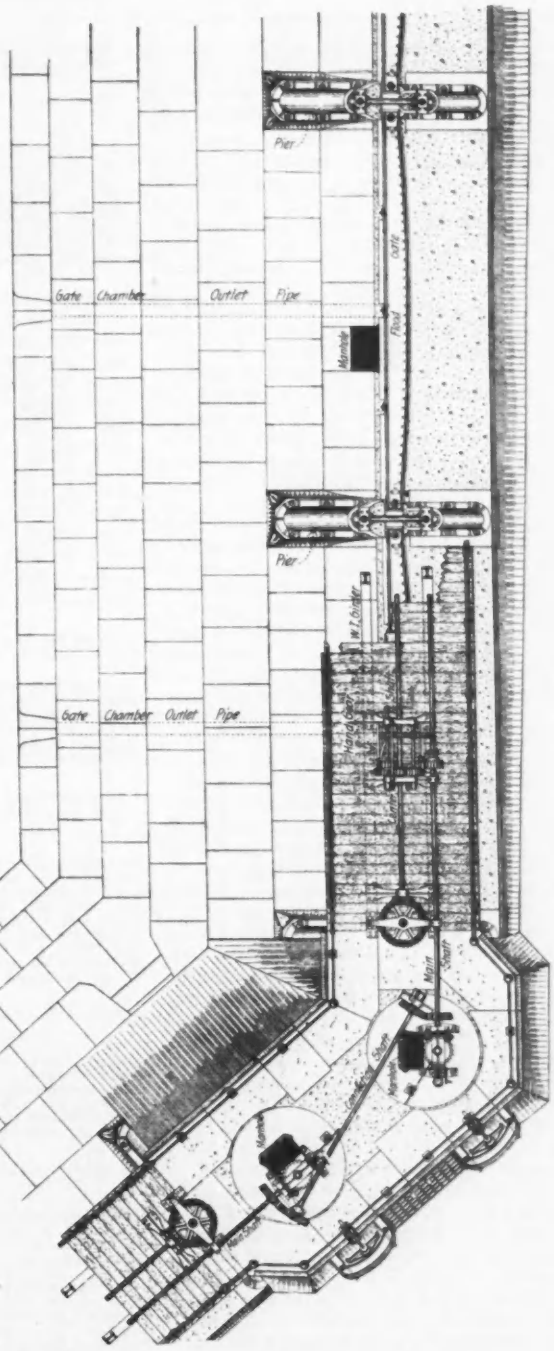


FIG. 5. TURBINE WELL, TURBINE AND GEARING.

THE GOULBURN DAM, VICTORIA, AUSTRALIA.

Stuart Murray, Chief Engineer,
Victorian Water Supply.

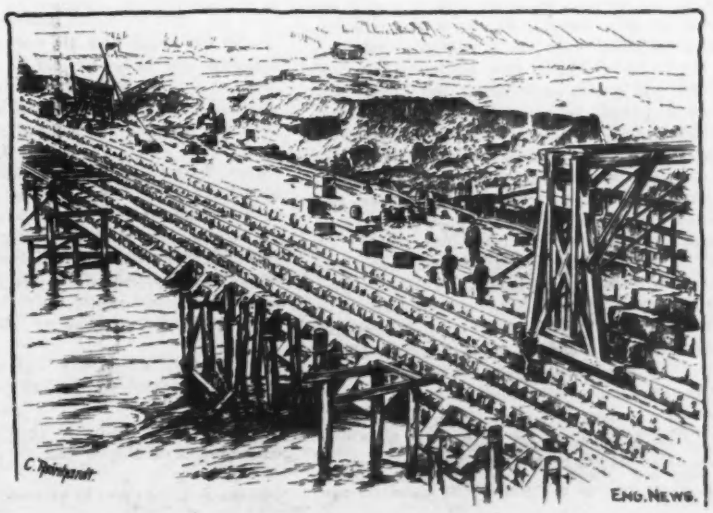
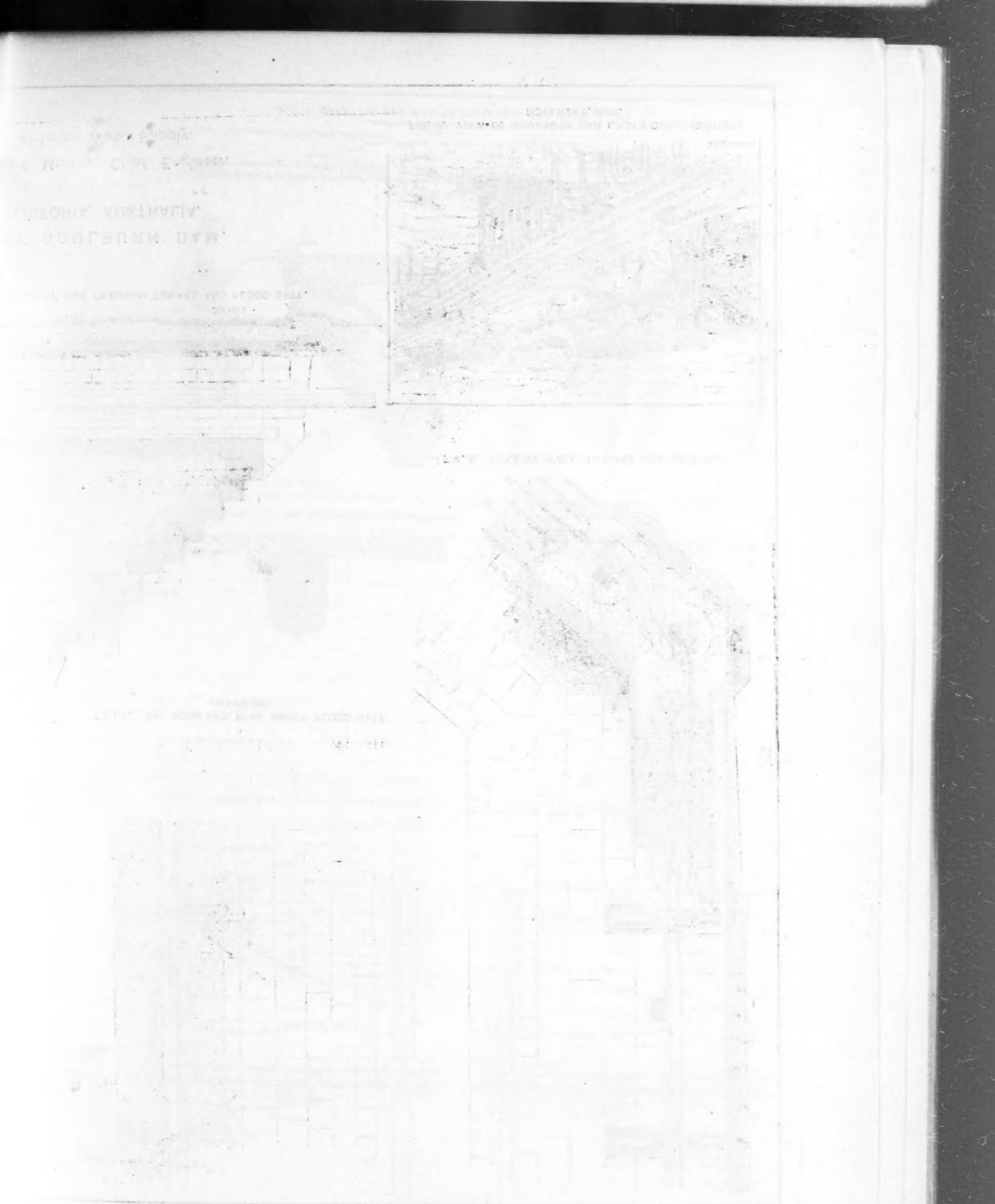


FIG. 9. VIEW OF GOULBURN DAM UNDER CONSTRUCTION, NOVEMBER, 1889.



to undertake a review of the general question of what is meant by the elastic limit, and to show how it may be determined with such a degree of accuracy as is necessary for engineering purposes.

With this in view, we have taken pains to examine what is said concerning the elastic limit by a number of standard authorities on strength and materials.

To begin with Barlow's "Materials of Construction," edition of 1851. On page 253 he records Telford's experiments on tensile strength of wrought iron as follows:

A bar of Swedish iron 1 in. square began to stretch with 17 tons, fagoted iron from scrap with 16 tons, and common Staffordshire iron with 19 tons. A cylindrical bar of common iron, 2 ins. diameter, at 45 tons began to stretch about 1-10 in. on 12 ins. in the middle; the machine being relieved, the bar shortened 1-40 in.

Here there is no evidence that there was any stretch of these bars within the elastic limit, it being stated that the bars "began to stretch" at 17 tons, 16 tons, etc., but in the 2-in. round bar the permanent set is seen, since when the machine was relieved the bar shortened only about one-fourth of the total extension.

In later experiments by Barlow, described on p. 300, the stretch within the elastic limit is apparent, and the elastic limit itself is discovered, although Barlow does not give it that name. In tests of 2-in. square bars, the stretch is measured by a multiplying apparatus for every increment of two tons of load, and is recorded in millionth parts of the total length. In one bar the increment of stretch for an increment of load of 2 tons, from 36 to 38 tons, is 95 millionths, and for the next increment of two tons the stretch is 145 millionths, when it is recorded that the "elasticity" is "exceeded." In another case the increment of load from 36 to 38 tons causes a stretch of 95 millionths, and the same stretch is given by the increment of load from 38 to 40 tons, and the remark is appended "elasticity perfect." In the test of a 1-in. bar, after the stretch begins to increase in a greater ratio than the loads, the remark made is "elasticity destroyed." In summing up the results of seven experiments, Barlow says:

We may consider, therefore, that the elastic power of good medium iron is equal to about 10 tons per inch. It appears, also, that a bar of iron is extended 1-10,000th part of its length by every ton of direct strain per square inch of its section, and consequently that its elasticity will be fully excited when stretched to the amount of 1-1,000th part of its length.

Translated into the language of more recent writers on strength of materials, Barlow's conclusion is equivalent to the statement that the elastic limit of good, medium iron is 22,400 lbs. per sq. in., and that its modulus of elasticity, or the load per square inch divided by the elongation per unit of length, is 22,400,000 lbs.

Turning now to more modern writers, Stoney, in his "Theory of Stresses in Girders and Similar Structures," edition of 1886, p. 5, says:

When any material is strained, either by a tensile or a compressive force, the elastic reaction of the fibers (equal to the applied force) is proportional to their strain (change of length), provided the stress does not exceed a certain limit beyond which the above stated law ceases to apply, and the strain, no longer regular, increases (sometimes with a sudden jump), more rapidly than either the stress or the reaction due to the elasticity of the fiber. This produces an appreciable set and ultimately rupture. Experience has proved that the safe working stress of any material does not exceed its sensible limit of uniform elastic reaction, generally called the limit of elasticity; indeed, it generally lies far within it. The limit of elasticity may also be defined to be the greatest stress that does not produce an appreciabe set.

In a footnote to the above, Stoney says:

What is here meant is the point where an obvious permanent set takes place on the removal of the load, and not where a set ascertainable only by delicate laboratory measurements begins, this latter being often reached at a stress far below the sensible limit of elasticity. On this subject the United States board appointed to test metals state, at p. 11 of their report, that "with due care in observing, the elastic limit as observed by first stretch is quite accurate enough for all practical purposes."

Clark's "Rules, Tables and Data," 1877, p. 500, says:

When stress is applied gradually to a solid body, the strain, or alteration of form, is proportional to the intensity of the stress so long as the alteration of form is within the elastic limit, the stress, at the same time, remaining within the limit of elastic strength. When the elastic limit is turned and exceeded, the body begins to yield under gradually accumulating stress, and the strain or alteration of form becomes proportionately greater and greater with the intensity of the stress, until, finally, rupture or breakage takes place. When a body is loaded in excess of the elastic limit without breakage, it returns when unloaded towards its normal form, but it fails to regain it. It is, in so far, sensibly deformed, and it has acquired a permanent set, or a set.

In Weisbach's "Mechanics," Coxe's translation, 1889, p. 371:

The capability of a body to resume its original form after the force which caused its change of shape has been removed, is called in the most general sense of the word its elasticity. The elasticity of every body has certain limits. If the change of form and volume exceeds a certain amount, the body remains of the same form after such a change, although the forces which have produced the variation have ceased to act. The limit of elasticity is very different for different bodies.

Weisbach's statement that when the change of form exceeds a certain amount the body remains of the same form after such a change, although the forces which have produced the variation have ceased to act, is not strictly true, for when the force —for instance, of tension—ceases to act, as when the load on a tensile test piece is removed, the bar shortens by an amount at least equal to the amount it would have shortened if the load had been removed just before the elastic limit was reached. The elasticity of a bar is not destroyed by stretching it beyond the elastic limit, but, on the contrary, it remains at least as great as it was before the stretching, and is usually greater, unless the stretching has been sufficient to cause an appreciable reduction of cross-section.

In Rankine's "Applied Mechanics," revised edition, 1891, p. 272, we find:

The elasticity of every solid is sensibly perfect when the strain does not exceed a certain limit. For every solid there are limits which, if a strain exceed, set, or permanent alteration of volume or figure is produced, and such limits of elasticity are less, and often considerably less, than the strains required to produce fracture.

Rankine seems to use the words "proof strength" as practically synonymous with "limit of elasticity," for on p. 274 he says:

It was formerly supposed that the proof strength of any material was the utmost stress consistent with perfect elasticity; that is, the utmost stress which does not produce a set. Mr. Hodgkinson, however, has proved that a set is produced in many cases by a stress perfectly consistent with safety. The determination of proof strength by experiment is now, therefore, a matter of some obscurity, but it may be considered that the best test known is the not producing an increasing set by repeated application.

Merriman, "Text Book of the Mechanics of Materials," third edition, 1891, p. 7, says:

The elastic limit is that unit-stress at which the permanent set is first visible, and within which the stress is directly proportional to the deformation. For stresses less than the elastic limit bodies are perfectly elastic, removing their original form on removal of the stress. Beyond the elastic limit a permanent alteration of shape occurs.

Thomas Box, "Strength of Materials," third edition, 1893, p. 399, says:

The elasticity of all bodies is imperfect, and manifests itself in two principal ways; first, by the extensions, compressions, deflections, etc., increasing more rapidly than the strains, whereas, with perfect elasticity they would be simply proportional to those strains. The second result of defective elasticity is that when once strained the body never returns to its primitive form, but takes a "permanent set," varying in amount very greatly with the nature of the material and the extent of the strain. In earlier days it was assumed that within what was termed the limit of elasticity, or with strains less than about one-third of the breaking weight, the elasticity of ordinary materials, such as cast and wrought iron, timber, etc., was perfect, the extensions, etc., being simply proportional to those strains, and giving no permanent set. But the refined experiments of Mr. Hodgkinson have shown that although this may be practically true with some materials, as wrought iron and steel, it is, in all probability not strictly true with any.

From the above extract we may make the following brief summary of the views of the different authors as to what the elastic limit is:

Barlow.—With good medium iron the "elasticity will be fully excited" when the bar is stretched 1-1,000th part of its length.

Stoney.—That point at which the stretch ceases to be proportional to the stress and "increases (sometimes with a sudden jump) more rapidly than the stress." The limit of elasticity may also be defined to be the greatest stress that does not produce an appreciable set. "The point where an obvious permanent set takes place, and not where a set ascertainable only by delicate laboratory measurement begins."

U. S. Testing Board.—"The elastic limit as measured by first stretch is quite accurate enough for all practical purposes."

Clark.—"When a body is loaded in excess of the elastic limit . . . it has acquired a permanent set."

Rankine.—"The elasticity of every solid is sensibly perfect when the strain does not exceed a certain limit. For every solid there are limits which if a strain exceed, set or permanent alteration of volume or figure is produced."

Merriman.—The elastic limit is that unit stress at which the permanent set is first visible and within which the stress is directly proportional to the deformation.

In the definitions given in the above brief summary there appears to be little or no difference of opinion among the several authors as to what they consider to be the elastic limit. Merriman's definition shows clearly that he considers the point at which permanent set is first visible, and that at which the deformation ceases to be directly proportional to the stress, to be one and the same point, and there is no evidence that any of the above-quoted authors made any clear distinction between the point where deformation first begins to be proportionately greater than the stresses, and the point where there appears a sudden increase in deformation (called by recent writers the yield-point), or considered that they were two different points instead of one point. Neither is there any evidence that they considered the words first visible, appreciable, obvious, to mean visible, appreciable, etc., to the eye when assisted by a microscope or micrometer capable of giving readings to 1-40,000 in., but it is plain that they used these words in the ordinary sense, meaning visible, etc., to the naked eye, the instruments of measurement being a pair of dividers and a finely-graduated scale.

The conflict of opinion as to what the elastic limit is began only when refined instruments of measurement came to be adopted in a few testing laboratories, and when it was discovered by means of these instruments that the deformation began to increase faster than the increase of loads (although at an exceedingly low rate, discoverable only by the finest instruments), at a point somewhat earlier in the test than that which had always been known as the elastic limit. In an actual test the fixing of this point is by no means an easy matter. It is like determining by the naked eye the point of junction or tangency between a very flat curve and a straight line, or rather it is still more difficult, for its determination, with any reasonable approach to accuracy, depends upon the accuracy with which readings are made upon a micrometer, and upon the accuracy of the micrometer screw itself, an error of 1-10,000 in. making a large error in the location of the point.

Bauschinger, as stated by Unwin, proposed to call this point the "limit of proportionality," and that would have been a perfectly proper and scientific name for it, its definition being that point at which the deformation begins to increase more rapidly than the stress. But Unwin, for what reason we know not, says, "It would be better to call it the elastic limit," thus giving these words a different actual significance than they had previously held, and making them to mean a different point than that which they formerly described. True, the words "elastic limit" had formerly been given the same definition in words, the point within which the stress is directly proportional to the deformation, but in the application of this definition extreme refinements of measurement were not adopted, and the point was located at practically the same point at which the first permanent set was visible, or at that which is now called the yield-point. Since this application of the words "elastic limit" by Unwin to a point to which they had not hitherto been applied, some other writers have followed his example and distinguished between what they call the yield-point and what they call the elastic limit. Much confusion of language, we think, would have been avoided if they had followed Bauschinger's suggestion and called the newly-discovered point the "limit of proportionality" instead of the elastic limit.

We now quote from Unwin, in his "Testing of Materials," and other writers who have followed him, in order to show in their own words what they consider to be the elastic limit and the yield-point. Unwin, on pp. 6, 18 and 64 of his work, says:

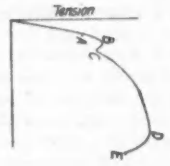
Certain materials, like cast iron, are not perfectly elastic in their initial condition for any straining action. They are permanently deformed, or take a permanent set with very small loads. But many materials are almost perfectly elastic, and most important materials of construction become so for a certain

range of stress. It is only within that range of stress that the ordinary rules of strength of materials are applicable. . . . It has long been known that the elastic limit of a bar is not a fixed limit. By loading and straining a bar in one direction the elastic limit for that kind of stress is raised. More recently it has been shown that if the bar is loaded and strained in different directions, the elastic limit may be lowered.

. . . (p. 18) When a body is subjected to the action of external forces it undergoes a deformation which either disappears if the load is removed (elastic deformation), or remains after the load is removed (plastic deformation). According to the best experiments, and especially those of Bauschinger, all the materials used in construction, except perhaps hard tool steel, show a small amount of permanent set after loading the first time, even if the loads are practically small. But in many materials, and up to a certain limit of stress called the elastic limit, the permanent sets are very small, and may perhaps rather be ascribed to initial want of straightness of the bars tested or to small defects of homogeneous than to any coherent property of the material.

The Yield Point.—In iron and steel, and perhaps other rolled or hammered materials, at a stress exceeding more or less the elastic limit, there occurs a large and almost sudden increase of deformation in the ordinary method of testing, and the deformation is permanent or plastic deformation. For greater stresses the plastic deformation increases, and it amounts, before fracture is reached, to many hundred times the whole elastic deformation. The point at which this almost sudden augmentation of plastic deformation occurs is termed the yield point, or breaking-down point. . . . The yield point is raised by a loading, which exceeds the primitive yield point, but it is not usually practicable to raise the yield point of a material artificially before using it in a structure, and consequently the primitive yield point—due to the mechanical operation of manufacture—fixes with respect to deformation the dangerous limit of stress.

(P. 64) Yield Point, or Breaking-down Point in Tension.—It is somewhat remarkable that amongst the ordinary materials used in construction, a tolerably perfect straight elastic line is chiefly found in the case of materials like wrought iron or rolled steel, which have been subjected to severe mechanical pressure in manufacture. For such materials, up to some point



A the line O A is extremely straight, and the stresses and strains are almost exactly proportional. Between A and B a sensible but slight curvature appears in the diagram, and a sensible though small deviation from proportionality begins to appear in the stresses and strains. Bauschinger calls the point A the limit of proportionality, but it would be better to call it the elastic limit. A little beyond the elastic limit, at B, there is for some rolled or hammered materials, a very singular and marked jump, or inflection. B C in the stress strain diagram. This point is very clearly marked in the diagrams of the Committee of Civil Engineers appointed to make experiments on steel (1870), and is shown in the figure, which is a plotting of two of their experiments on steel. The committee calls this point the yielding point. The behavior of the material at this point was very accurately described by Bauschinger in 1879, and he adopted for it the name "Streckgrenze." Bauschinger indicated the very great suddenness of the increase of extension, lateral contraction, and temperature. In 1881 Prof. Kennedy called attention to this peculiarity in rolled steel and gave to the point A the name "breaking-down point." On the whole, this term seems very suitable, if by breaking down is understood a breaking down of the primitive molecular arrangement. . . . Probably the breaking-down point is a kind of physical record of the condition of constraint in the bar at the moment of rolling or hammering. . . . It is probable that at the breaking-down point a mechanically produced condition of aggregation is passed, and the artificially-created rigidity suddenly gives way. Beyond the inflection at the breaking-down point, the partly plastic, partly elastic, extension proceeds regularly again. But the precise extension for any load between B and C depends more or less on the time during which the load acts. During any pause in this part of the curve the extension increases without increase of load, and when the load is increased again the rigidity of the bar is found to be greater than before, and the curve becomes steeper.

The Committee of the American Society of Mechanical Engineers on Standard Tests and Methods of Testing Materials, in a circular issued by them in 1886 concerning a series of projected tests of iron and steel bars, to be made in the laboratories of various manufacturers, request that observations be made of the elastic limit and of the ultimate strength of these bars. The yield-point is not mentioned in this circular.

In the committee's "General Recommendations," "Transactions of the American Society of Mechanical Engineers," vol. XI., p. 623, they give the following specifications:

In recording the results of tests, loads at elastic limit, at yield-point, maximum, and instant of rupture are all to be noted.

The load at elastic limit is to be that stress which produces a change in the rate of stretch.

The load at yield-point is to be that stress under which the rate of stretch suddenly increases rapidly.

Mr. G. C. Henning, in his paper on "The Elastic Curve and Treatment of Structural Steel," "Transactions American Society Mechanical Engineers," vol. XIII., p. 579, describing his tests of ¾-in. steel rods, says:

The elongation was invariably measured on 8 ins. of length. . . . The modulus of elasticity was determined from the elongation due to a load of about 20,000 lbs. per sq. in. between 4,000 and 24,000 lbs., thus eliminating the initial error due to adjustment of instrument or straightening of rod in the wedges, which produces unavoidable error. The measurements of elongation by micrometer were made by means of a Marshall double electric contact micrometer. The yield-point was observed by stretch measured by calipers and corroborated by drop of the beam. The loads were applied at a uniform rate, only stopping long enough at loads of 2,000 and 12,000 lbs. (about 4,000 and 24,000 lbs. per sq. in.), to take micrometer readings of elongation, and so as to produce about 2½ per cent. stretch per minute.

On p. 580, describing tests of pieces cut from finished bars, he says:

Wherever it has been observed, the elastic limit has been given as well as the yield-point, the latter corresponding to drop of beam, the former determined by micrometer measurement verified by plotted curve. The yield-point as here given is what is commonly, though erroneously, called the elastic limit.

Having reviewed some of the principal authorities upon the subject, let us see what, in the light of modern knowledge and practice in the testing of materials, should be the position of the engineering profession on this important matter.

Let us consider first the case of a test of a bar of steel of 1 sq. in. sectional area and 8 ins. in length between the points at which the measurements of elongation are taken. Suppose we make the test in a 100,000-lb. testing machine driven by screws operated slowly by hand. On such a machine the weighing of the strain is done by a platform scale. Suppose the total motion of the beam between its upper and lower stops is 1 in., and a pointer on the beam divides this inch into 10 parts, the zero point being marked in the middle.

The test piece being properly centered in the jaws of the machine, and the beam balanced at zero, the poise weight on the beam being also at zero, the test is begun. One man turns the crank, a second watches the pointer on the beam and shifts the poise, and the third watches the stretch of the piece. He has a pair of dividers in his hand, the point of one leg being inserted in a fine prick-punch mark on the specimen, and the point of the other leg resting on a mark scratched across a chalked surface 8 ins. distant from the punch mark. The test proceeds as follows: The poise is placed in the 4,000-lb. notch, the end of the beam drops to its lowest position, the crank is turned slowly, and soon the beam rises. The observer of the beam cries "Hold!" the crank-turning is stopped and again proceeded with very slowly until the pointer of the beam is opposite the zero mark. The bar is now sustaining a steady load of 4,000 lbs. The observer of the stretch makes with his dividers a scratch on the chalked surface, with the result of a slight thickening only of the mark first scratched, indicating an elongation of less than 1-100 in. This, experience tells him, is a slight stretch due possibly to relieving of some internal strain in the bar, and is not an elastic stretch. Twenty-four thousand lbs. is then applied in like manner, and the man with the dividers cannot see any appreciable change. Two thousand lbs. at a time is added, until at 36,000 lbs. the observer at the dividers thinks his scratched line has gradually grown till it is almost 2-100 in. thick; but he has no evidence yet that the elastic limit has been reached. Now the test is continued with still greater care; the poise is moved forward only 500 lbs. at a time, and the crank turned gently, so that the observer at the beam can watch the beam slowly rise to its zero position. Every time the poise is moved forward 500 lbs. the beam drops, and when the crank is turned it slowly rises. When 38,500 lbs. has been placed on the beam the crank-turner notices that he has to turn the handle more than two whole revolutions in order to raise the beam to the zero point, instead of about 1½ revolutions, as heretofore, for increments of 500 lbs. of load. When the beam reaches the zero point and the crank-turning is stopped, the beam does not remain at zero as before, but slowly descends. The observer at the dividers makes a scratch on the chalked surface, and the scratched line seems to be a distinct line from the one scratched at 36,000 lbs., and not coincident with it, and he thinks he has found the elastic limit. Here are three indications which occur simultaneously while the load is being increased from 38,000 to 38,500 lbs.: first, the increased number of turns of the crank required to raise the beam; second, the slow drop of the beam after it has been raised; third, the apparent increase of elongation. None of these indications is entirely conclusive, however; they need confirmation; therefore 500 lbs. more is placed on the beam, making 39,000 lbs.; four turns are required to raise the beam; it drops not slowly, but instantly; a scratch on the piece thickens the line last made, and shows certainly a space between it and the 36,000-lb. line which is too great to represent elastic stretch. A fourth indication also appears—viz., the cracking of scale on the specimen. These observations confirm the original indications, and the elastic limit is recorded at 38,500 lbs.

The test thus described illustrates exactly the method followed in college laboratories and in some steel works about the year 1879, before steel was extensively used in construction, and before steam-driven testing machines were known. Suppose we now test a duplicate of the bar whose test has already been described by the modern quick-steel works method.

The machine is driven by a belt from a shaft so speeded (as stated in the above quotation from Mr. Henning's paper) as to cause a stretch of about 2½ per cent. per minute. If the elastic limit were 40,000 lbs. per sq. in. and the piece were 8 ins. long, this rate of stretch would cause the elastic limit to be reached in about three seconds, provided the piece were perfectly straight, had no internal strain or want of homogeneity, and that there were no "give" in the grip of the piece in the jaws nor in the parts of the machine itself. These all tend to lengthen the time within the elastic limit may be reached, but three seconds will probably cover the whole time which is taken during the application of the last 5,000 lbs. per sq. in. before the elastic limit is reached. In this test there is only one observer. After putting the piece in the machine and seeing that its number, dimensions, etc., are properly entered in the record book, his work consists in watching the beam, shifting the poise and throwing the handle of a friction clutch when he desires to start or stop the machine. He places 30,000 lbs. on the beam, starts the machine, watches carefully for the beam to rise, and then moves the poise forward at such a rate as to keep the beam floating just above the zero point. If the beam hits the upper stop he pushes the weight a little farther ahead, so as to bring it down; if he pushes it too fast the beam hits the lower stop, and he has either to push the poise backwards or to wait until the beam rises again from the increased pull on the test-piece. A skillful operator, however, will generally keep the beam floating, the moving forward of the poise and the stretching of the piece proceeding at a uniform rate. Suddenly the beam drops to the bottom stop, and a second or more elapses before it rises again. The observer notes this point as the elastic limit, and he makes the figure 40,000 lbs. instead of 38,500, the figure obtained in the old-fashioned slow test. The load of 38,500 was passed two seconds before the load of 40,000 lbs. was recorded, but there was no indication of drop of the beam nor of scaling of the specimen. It is evident, therefore, that time is an important element in determining the elastic limit by the drop of the beam.

Let us next take another sample of the bar to one of the recent writers who have introduced the term yield-point, and ask him to test it on the same 100,000-lb. testing machine. He applies to it a double electric contact micrometer, graduated to 1-10,000 in., and capable of being read to a quarter of one division, but the error of the screw itself is possibly equal to a half division at some parts of its range. This instrument is used to determine the elongations within the elastic limit. The machine is worked slowly by hand up to or a little beyond this limit, and then the gearing is connected and the test is finished as in the steel works test. The following is the record obtained. (This is the record of an actual test, No. 819, in Mr. Henning's paper, "Transactions of the American Society of Mechanical Engineers, vol. XIII., p. 593, with the micrometer readings converted into elongations in 8 ins. by subtracting 144-10,000, which is the apparent error of the reading of the stretch caused by the

first load. The readings are in 10,000ths of an inch.):

Load per sq. in., lbs.	Elongation in 8 ins., %	Increase of elongation, %	Increase of elongation per 1,000 lbs., %
3,860	10.5	10.5	2.72
30,900	85.	74.5	2.76
32,830	90.25	5.25	2.72
33,800	92.5	2.25	2.32
34,760	95.75	3.25	3.39
35,700	98.5	2.75	2.93
36,690	101.75	3.25	3.28
37,170	103.13	1.38	2.88
37,660	105.	1.87	3.82
38,140	106.75	1.75	3.65
38,620	109.	2.25	4.69
39,110	113.5	4.5	9.19

The elastic limit is given by Mr. Henning in this test as 35,700 lbs. per sq. in., and the yield-point at 40,000 lbs. per sq. in. An inspection of the figures in the last column shows what an extremely difficult matter it is to fix the elastic limit if that point is to be defined as the point at which the rate of stretch begins to be greater than the rate of increase of load, or, in the words of the committee of the American Society of Mechanical Engineers, that stress which produces a change in the rate of stretch. Take the following figures of rate of stretch per 1,000 lbs. in order from the last column:

2.72; 2.32; 3.39; 2.93; 3.28; 3.82; 3.65.

How shall we fix from these the point at which the rate of stretch changes, and in view of the possible error of any one or more of the readings of as much as half a ten-thousandth, how shall we determine whether the apparent fluctuations of the rate are due to variable errors of reading or to fluctuations in the actual rate of stretch of the material? Suppose we assume errors of 0.25 and 0.5 in some of the readings, and endeavor to correct the figures so as to make them show a somewhat regular increase as follows:

	2.72	2.32	3.39	2.93	3.28	3.82	3.65
Correction.		+.50	−.50		−.25	−.25	+.25
	2.72	2.82	2.89	2.93	3.03	3.69	3.90

The rate of stretch now appears to change at the second figure, or 2.82, corresponding to a load of 33,800 lbs., instead of 35,700 lbs., which is taken as the elastic limit by Mr. Henning, or 1,900 lbs. earlier. If this be considered doubtful because we have arbitrarily added a supposed error of 0.50, then we must admit that the rate has certainly changed at the next figure, 2.89, because that figure is obtained by subtracting 0.50 from the observed reading. This corresponds to a load of 34,760 lbs.

But this discussion of the precise position of the elastic limit as determinable by micrometer measurements is splitting hairs of exceedingly small diameter, for we are now dealing with millionths of an inch. Thus, the differences in the rate of stretch, as corrected, for four increments of load are respectively 10, 7, 4 and 10 millionths, when the micrometer itself has a possible error of 50 millionths, and it cannot be known whether the fluctuations in readings are due to errors of reading, to errors of the measuring instrument, or to actual fluctuations in the rate of stretch itself.

It may safely be predicted that four different men, all equally skilled in the art of making minute measurements, testing independently bars which are exact duplicates of the bar whose record is given above, using the same testing machine and the same micrometer, would obtain for the point at which the rate of stretch begins to change figures varying at least as widely as the four consecutive figures in the above record, 33,800, 34,760, 35,700 and 36,690.

The definition given by the committee of the American Society of Mechanical Engineers—viz., "the load at the elastic limit is to be that load which produces a change in the rate of stretch"—is therefore susceptible of a rather elastic interpretation. In view of the record above given, the definition might be interpreted as follows: The load at the elastic limit is that load which the operator, after inspection of his record of elongations, believes to have produced a change of elongation in 8 ins. of from 4 to 10 millionths of an inch, the measuring instrument having a possible error of 50 millionths; and different experimenters testing the same bar may vary in their judgment as to the precise amount of this load to an extent of about 3,000 lbs. per sq. in.

Let us now consider the question of the yield-point. The committee defines it thus: "The load at yield-point is to be that stress under which the rate of stretch suddenly increases rapidly." In the record of the test above given, between the loads 38,620 and 39,110 lbs. per sq. in., the stretch "suddenly increases rapidly" from a rate of 4.69 to a rate of 9.19 ten-thousandths of an inch per 1,000 lbs. increase of load. The latter rate is more than three times the normal rate of elongation within the elastic limit, and following the definition, we might think that to be the yield-point. Mr. Henning, however, puts the yield-point at 40,000 lbs. It appears, therefore, that the location of the yield-point varies with the judgment of the observer and with his interpretation of the meaning of the words "suddenly increases rapidly."

Suppose that successive rates of increase of stretch per 1,000 lbs. increase of load are obtained as follows, in ten-thousandths of an inch:

3, 3, 5, 8, 12, 17, 24, 36, 50, 60.

At what point in the series can it be said that the rate "suddenly increases rapidly"? Yet such readings of rates of increase are quite likely to be obtained in a test. It is evident, therefore, that the yield-point as recently defined is just as uncertain a point as the elastic limit when the latter is defined as the point at which the rate of stretch begins to increase.

If the yield-point be taken as that point in the test at which the beam drops, or at which there is a sudden increase in stretch large enough to be determined by the dividers, or an "appreciable" permanent set, or at which the scale on the specimen begins to crack, we have already shown that that point varies according to the speed with which the testing machine is run. This fact is clearly shown in the letters of Mr. Cunningham and Mr. Webster in our issue of July 4. Mr. Cunningham quotes the average results of two groups of five tests each of uniform material, with the testing machine run at the rate of ¼ in. per minute, the figures being respectively 40,620 and 41,200 lbs. per sq. in. Another group of like material, when the machine was run at the rate of 15-16 in. per minute, gave an average figure of 44,450 lbs. Mr. Webster, describing the methods used in steel works at the present day, when an operator is called on to make 20 to 30 and over 40, tests per hour, states that he knows of cases in which the test-piece had stretched 3-10 in. at the elastic limit reported. "In other words," he says, "by the present methods in use no reliance whatever can be placed on the elastic limits reported."

In the test by micrometer measurements given above, we have shown that the "elastic limit," so called, defined as the point at which the rate of stretch begins to change, may be anywhere between 33,800 and 36,690 lbs. per. sq. in.; if taken at the point at which the rate of stretch increases to a rate more than three times the rate within the elastic limit, it would be 39,110 lbs. Mr. Henning gives the "yield-point" at 40,000 lbs. determined by "drop of the beam," and if the "scale beam elastic limit," as it is called by Mr. Cunningham, were determined at the highest rate of machine mentioned by him—viz., 15-16 in. per min.—there is little doubt that the figure would be as high as 44,000 lbs.

All this discrepancy in the results is due to a departure from the methods of test that were in use before the day of the introduction of minute measurements and of steam-driven testing machines. If the bars were tested by the old method—a screw machine operated by hand-power—slow motion, small increments of load and careful observation of the following four phenomena—viz., number of turns of the crank to produce a given increase of stress, drop of the beam after raising it to the zero point, increase of elongation measurable by dividers and cracking of the scale on the specimen, we believe that any number of different experiments would agree in placing the elastic limit at between 39,000 and 40,000 lbs. At 39,000 lbs. the rate of increase of stretch is over three times that of the increase within the elastic limit. This, however, could not be determined by the dividers, as the increase is only 9-10,000 in., but it would be indicated by the turns of the crank, three times as many turns being required to produce 1,000 lbs. increase of stretch as were required during the test at any period of 1,000 lbs., between 4,000 and 34,000 lbs. When the rate of stretch increases to as much as three times, the elastic rate flow has commenced; flow takes time, and if there were a second or two's delay after raising the beam with 39,000 lbs. on it, the beam would drop if not to the bottom stop, at least such a distance that it would be easily seen if a pointer traversing a graduated scale were used.

This was the old way of testing. It gave results which were far more uniform than those obtained in the present day. There was then no difference of opinion as to what was meant by the words "elastic limit," and the term "yield-point" was unheard of.

Two changes in method of test have led to the present confusion. First, the introduction by scientific experimenters of the double electric contact micrometer, for the purpose of making much more accurate measurement of elongations than those formerly made, and the discovery that the change, although an extremely slight one, of the rate of increase of stretch took place at a point much earlier than the point which had theretofore been known as the elastic limit. This new point was given a new name by Bauschinger, who called it the "limit of proportionality," but Unwin thought the old name of elastic limit was a better name for it, and some modern writers, and notably the American Society of Mechanical Engineers' committee, have unfortunately followed Unwin, and given the old name to a new thing, and a new name—"yield-point"—to the old thing, which was always before known as the elastic limit.

The second change was due to the greatly increased demand for testing made upon the steel works by bridge-building engineers and contractors, and the consequent increase of speed at which testing machines were driven. The drop of the beam, which was a quite satisfactory and sufficiently accurate method of obtaining the elastic limit when machines were driven by hand, was continued as being the most convenient method for rapid testing, but as the machines came to be driven faster and faster, the error which made the apparent elastic limit increase with the rapidity of driving, was lost sight of. The evil of rapid driving has now become so great that, in the words of Mr. Webster, no reliance whatever can be placed on the elastic limits reported.

Lest the argument we have made concerning the difficulty of determining the elastic limit, defined as the point of first increase of the rate of stretch, as determined by micrometer measurement, be considered defective because it is based on a single case, we have taken six other cases from Mr. Henning's paper in vol. XIII., "Transactions of the American Society of Mechanical Engineers," and reduced them to a common basis by interpolation to obtain the rate of increase for each 1,000 lbs. of load, and by eliminating the error of the first reading by taking the stretch of each for a load of 4,000 lbs. per sq. in. at 10.7 ten-thousandths of an inch, in 8 ins., corresponding to a modulus of elasticity of 30,000,000. The following is the record as thus modified:

	Test No.					
	765.	901.	728.	707.	720.	1,092.
Load per sq. in.	Increase of elongation in ten thousandths of an inch per 1,000 lbs. per sq. in.					
4,000	2.7	2.7	2.7	2.7	2.7	2.7
10,000	2.5	2.5	2.6	2.1	2.1	2.5
15,000	2.7	2.4	2.7	2.6	2.3	2.6
20,000	2.9	2.5	2.6	2.9	2.3	2.6
22,000	...	...	...	...	3.9	....
24,000	...	...	...	...	4.	....
25,000	2.9	2.7	2.9	2.6	5.	2.7
26,000	...	...	...	...	5.	....
27,000	3.2	...	..	2.6	4.5	....
28,000	4.	...	...	...	8.5	....
29,000	4.	...	3.0	3.1	8.	....
30,000	4.	2.7	3.1	2.9	10.	3.
31,000	4.6	...	...	2.9	....	12.
32,000	5.4	...	3.3	3.5	14.	18.
33,000	...	2.7	4.8	4.	19.	....
34,000	...	3.	5.	4.5	....	....
35,000	...	3.	15.	11.5	....	....
36,000	...	2.5	....	....	....	....
37,000	...	3.5	....	....	....	....
38,000	...	7.	....	....	....	....
El. limit, lbs.	28,300	33,220	32,000	34,300	27,000	30,500
Yield-point, lbs.	36,400	40,200	34,850	35,580	34,390	34,060
Ult'e stgth, lbs.	69,500	70,850	71,570	67,170	65,880	68,680

The figures in the last three lines are those given by Mr Henning. In percentages of the ultimate strength they are as follows:

El. limit, per cent.	40.7	46.9	44.7	50.1	41.0	44.4
Yield-point, per cent.	52.5	56.9	48.7	52.9	52.2	47.6

It will be observed that the elastic limit percentages in every case but one are below 50 per cent. The yield-points also in every case but one are be-

low the lowest percentage given by Mr. Cunningham in his letters in our issue of July 4.

In the above table we have underscored the figure below that at which Mr. Henning places the elastic limit. In test No. 765 it will be observed that the elastic limit might be taken at any point between 27,000 and 32,000 lbs. with as much reason as it is placed at 28,300 lbs.; that in test No. 901 there is as much reason for placing it at 36,000 lbs. as at 33,220 lbs., and in No. 728 it is at least doubtful whether it should not be placed at 34,000 instead of at 32,000 lbs. In No. 707 it is not apparent why it should not be placed at 28,000 lbs. instead of at 34,000 lbs. In No. 720 Mr. Henning places an interrogation mark after his figure of 27,000 lbs., and, if his definition of the elastic limit is the point at which the rate of stretch first increases, it would seem as if it might be placed between 20,000 and 22,000 lbs.

In five cases out of the six chosen, therefore, it appears to be a matter of extreme difficulty to fix upon the position of the elastic limit, if we define it as the point at which the rate of stretch first changes, and attempt to determine it by means of a micrometer screw reading to ten-thousandths of an inch. If, now, it were to be defined as the point at which the rate of stretch first appears to be three times or four times as great as the normal rate of stretch for the first 20,000 lbs. per sq. in., or rather the normal rate between 4,000 and 24,000 lbs. to eliminate the unavoidable error of readings at the beginning of a test, we would have a point which could be located with ease on any test record, the readings of which gave elongation for each 500 lbs. per sq. in. increment of load; for as soon as the rate of stretch becomes as great as three times this normal rate, it very rapidly increases to four, five or six times this rate. The normal rate per 1,000 lbs. corresponding to a modulus of elasticity of 30,000,000 is 2.7 ten-thousandths per 1,000 lbs., in an 8-in. specimen, and if we should take the elastic limit as the point at which the rate of stretch first appears to be 10 ten-thousandths in., or 1-1,000 in. per 1,000 lbs. of load, we would have a point which could be determined in the record of a micrometer test with far greater exactness than it can be under the definition of first change of rate of stretch, and one which would correspond very closely, sufficiently so for practical purposes, with the elastic limit determined without a micrometer by a screw-testing machine run by hand, by observing the change in the number of turns of the crank required to cause an increase of 500 lbs. of stress, and by the drop of the beam, when a second or two of time is allowed to elapse for the purpose of determining whether the beam drops or not.

Let us now consider some of the reasons, apart from possible errors of measurement by micrometers, why the rate of stretch of a bar of steel may fluctuate, and thus make it difficult to determine the location of the elastic limit, and why different experimenters are apt to get different values for the elastic limit and for the yield-point for the same piece of steel. If we have a piece of steel which is perfectly uniform in chemical composition, perfectly homogeneous as to molecular structure, and uniformly tempered in every portion, we can easily imagine that if tested by dead loads placed upon it at uniform intervals of time in small increments, measurements being made accurately by a micrometer, the recorded figures, when plotted, would make a regular curve. The figures might run as follows:

Load per sq. in.	Stretch per 1,000 lbs.	Difference.
4,000 to 24,000	2.70	.....
34,000	2.70	.0
35,000	2.71	.01
35,500	2.72	.01
36,000	2.73	.01
36,500	2.75	.02
37,000	2.77	.02
37,500	2.80	.03
38,000	2.85	.05
38,500	2.95	.10
39,000	3.10	.15
39,500	3.35	.25
40,000	3.85	.50
40,500	4.85	1.00
41,000	6.85	2.00
41,500	10.85	4.00
42,000	21.	10.
Same cont. 10 secs.	31.	10.
42,500	51.	20.
Cont. 10 seconds.	61.	10.

The last four readings would cause the curve to lose its regular form, and would give it a couple of steps, showing the effect of flow during a period of 10 seconds. From this record it would be difficult to fix the elastic limit or the yield-point by any of the definitions. The rate of stretch appears to increase at 35,000 lbs., but the increase of the rate is only 1-1,000,000 in., far within the probable error of the screw of the micrometer. Shall we take 2 or 3, or 5 or 10 millionths as the figure for the increase of rate of stretch which is probably beyond the limit of error of the instrument, and shall we fix the elastic limit correspondingly at 36,500, 37,500, 38,000 or 38,500 lbs.? By our proposed definition of the elastic limit as the point at which the rate of stretch first becomes three or four times the normal rate below 24,000 lbs., there is no difficulty in fixing it at 41,500 lbs., and this would probably be the point at which it would be fixed in a test in a screw power-testing machine operated slowly by hand, using the number of turns of the crank and the drop of the beam as indications. Using the dividers to obtain the point at which the stretch appears to be certainly greater than that due to elastic stretch—say, the point at which the total stretch is approximately 2-100 in.—it would be fixed probably at 42,000 lbs. If we wish to determine the so-called yield-point, defined as the American Society of Mechanical Engineers' committee defines it, the point at which the rate of stretch "suddenly increases rapidly," shall we take 41,500, 42,000 or 42,500 lbs. as that point. Of three different observers each one might take a different one of these three figures. If we refer to Unwin, and take the yield-point as that point at which there is "a large and almost sudden increase of deformation," how shall we determine just what is meant by the words "almost sudden," and how shall we locate the point at which this "almost sudden" event takes place?

But the case is still more difficult when we deal with actual steel, and not with our ideal steel, perfectly uniform in analysis, perfectly homogeneous in molecular structure, and of uniform temper throughout.

A bar of steel is apt to be higher in chemical impurities in its central than in its exterior portion; its temper may vary in the exterior and in the interior, and in different portions of its length. The fact that a bar usually "necks down" before breaking—some bars necking more than others—shows that the testing machine discovers that one portion of the length of a bar is softer or weaker than another. What more likely, then, than that different portions of a bar have different elastic limits. In testing such a bar, one portion of the bar will stretch beyond its elastic limit, take a permanent set, have its elastic limit raised by resting under strain, etc., before the adjoining portions reach their several elastic limits. The stretch of the first portion may be microscopic, but a series of such stretchings may be the reason why actual test records show such irregularities as those in the records we have taken from Mr. Henning's tests.

After the elastic limits of all portions of the bar have been certainly passed, as shown by the cracking of the scale over the whole length, flow begins, but this flow is a curious phenomenon. It sometimes takes place irregularly, as if when the particles of metal began to flow over each other they encountered a frictional resistance, such as that between imperfectly lubricated surfaces, which alternately slide, then seize, then slide again. Again, time is an important element in the rate and extent of flow. As Unwin says: "But the precise extension for any load between B and C depends more or less on the time during which the load acts. During any pause in this part of the curve the extension increases without increase of load, and when the load is increased again, the rigidity of the bar is found to be greater than before, and the curve becomes steeper." All these phenomena and conditions—viz., the want of homogeneity as to analysis, structure and temper, the stretching of one portion of a bar before another, the alternate holding on and letting go, first of one portion and then of another, the increase of elastic limit and of yield-point (if these are two different points) by resting under strain, and the effect of time on flow, increase the difficulty of locating the yield-point, whether defined as the point at which the rate of stretch "suddenly increases rapidly," or as the point at which there is a "large and almost sudden increase of deformation." The matter is still further complicated when it is attempted to determine the yield-point by the drop of the beam when a screw-testing machine is run at such a speed that the strain may be increased 3,000 lbs. in two or three seconds, and when the actual elongation found at the instant the beam drops, is 3-10 in., as related by Mr. Webster.

Having thus shown the impossibility of determining by micrometric measurement the elastic limit when it is defined as the point at which the rate of stretch begins to change, and the extreme variability of the position of the so-called yield-point with the method of running the machine and with the method of measuring and recording results, had we not better drop these new definitions and methods of attempting to locate points whose position is so extremely variable and whose determination depends so largely upon the personal equation of the observer, and returned to the good, old-fashioned definitions and methods. If for scientific purposes there is any need for determining microscopically that point at which the rate of stretch begins microscopically to change, let us call that point the "limit of proportionality," as Bauschinger did, and leave its determination to the college professors. Let us keep the old term elastic limit with its old significance, as that point at which a permanent set visible to the naked eye takes place, at which rate of stretch increases, so that the increase may be (albeit with some difficulty) distinguishable by the use of a pair of dividers and a magnifying glass, or more easily and certainly, by the drop of the beam, or by the increase in the number of turns of the crank needed to produce a given increase in stretch. For the purpose of determining this elastic limit, let the testing machine be run by hand until the limit is passed, and the record taken (or run by hand between the load of 30,000 lbs. and the elastic limit), and then let the power gear be thrown in and the test completed in the present rapid fashion. Since the term "yield-point" is quite recent, and it has no meaning essentially different from the words elastic limit in time-honored practice, why need it be used at all?

We have gone into this subject at great length, but we believe that it is by no means as fully treated as it might be. We might enter into the question raised by Mr. Cunningham, of what use is the elastic limit in engineering specifications, but that might provoke more discussion than the present one, and may well be left to a future time. Let us settle this question first: If the elastic limit is to continue to be included in specifications, what does it mean, and how is it to be determined? We will be glad if some of our bridge engineers, steel manufacturers and testing laboratory men will furnish us further light upon the subject, and indicate some way by which a uniformity of definition and of practice in regard to it may be arrived at.

LETTERS TO THE EDITOR

THE STAND-PIPES AT ST. BERNARD, O., AND FORT ETHAN ALLEN, VT.

Sir: My attention has been drawn to what seem to be errors, typographical or otherwise, in the descriptions of the stand-pipes at St. Bernard, O., and Fort Ethan Allen, near Burlington, Vt., which appeared in Engineering News, of May 23 and 30, respectively. The former of them is an obvious misstatement of the percentage of phosphorus found by test to be contained in the steel plate used in the St. Bernard standpipe, the correct amount doubtless being 0.02%, instead of 0.2%, as printed in the table of tests in the middle of p. 331. This correction is of importance, because the statement following the table is apt to be overlooked.

The other case of apparent error is in the ductility requirement for the steel plate used in the water tower at Fort Ethan Allen. Near the top of the middle column, on p. 350, it is stated that the steel was required to be "sufficiently ductile to admit of rolling while cold around a radius of 20 ins. without developing flaws or cracks." The thickness of the plates are stated to range from 7-16 in. at the bottom to 3-16 in. at the top, so that the diameter of the cold bend circle (40 ins.) would vary from upwards of 90 times the thickness of the plate in the case of the thickest, to more than 120 times in the thinnest of the plates used. In view of the current practice of specifying a

cold bent flat or, at the most, that the diameter of the bent piece on the concave side shall be not more than 1½ times the thickness of the sample, it seems pertinent to inquire whether the ductility requirements in this case have been correctly published; particularly in view of the fact that no other physical test, save the tensile strength, is stated, and chemical requirements are omitted altogether. Yours respectfully,

William D. Pence.

Champaign, Ill., June 14, 1895.

(The figures for phosphorus were a misprint. As to the ductility requirement, inquiries addressed to Capt. Guy Howard, U. S. A., in charge of construction at Fort Ethan Allen, have brought no reply.—Ed.)

THE ILLINOIS "DEEP WATERWAY."

Sir: In your issue of July 11 you have endeavored editorially to render abortive the attempt of the people of this state to connect the Great Lakes and the Mississippi River by a channel commensurate with the requirements of the vast territory which such a commercial waterway would reach.

Having a thorough understanding of Senate Bill No. 457 and an intimate knowledge of the objects sought in the passage of the bill, I am not a little surprised at the glaring misstatements of fact which your paper is editorially guilty of.

In the first place, if you were more thoroughly acquainted with the matter you would be in a better position to judge as to whether the scheme is "quixotic," as you choose to term it. The bill was prepared and sent to Springfield under the auspices of the Chicago Board of Trade. It passed the state senate by nearly a three-fourths vote, and in the house the vote stood 106 ayes to 2 nays. This would seem to indicate that the people of Illinois do not consider the scheme "quixotic."

Twice has our general assembly passed resolutions clearly defining the policy of our state in this matter, and there is no doubt that the vast majority of the people of the state are not in favor of the 7-ft. ditch down the valley of the Illinois heretofore advocated by the U. S. Engineers. Nor do they favor the maintenance of the locks and dams on the lower Illinois when a far better boating-stage can be obtained and maintained by their removal, in conjunction with easy dredging and an adequate supply of water from Lake Michigan.

Your editorial would seem to indicate that there was some ulterior, hidden purpose lying under the surface of the bill which could only be ascertained by "reading between the lines," and that such purpose was "to secure the appointment of a 'Commissioner of Waterways,' who was to receive a salary of $500 per month for two years, and whose duty was to expend the balance of an appropriation of $25,000 as he saw fit."

There is universal comment among engineers regarding the small pay received by members of our profession, as compared with those of other professions, and yet your paper, editorially, objects to the state of Illinois giving an engineer $11,000 for a comprehensive, preliminary report upon the feasibility, advisability and approximate cost of rendering many of the streams of our state navigable, including a trunk waterway to connect Lake Michigan and the Mississippi River.

You also say that the "survey" of the Illinois River can better be done by the U. S. Engineers than by a state commission. The bill in question did not contemplate a "survey" of the Illinois River. The work called for by the bill never has been, and, I venture to say, never will be, done by U. S. Engineers. We, who live in the valley of the Illinois River, well know the delays incident to such government work. The proposed work is not of local interest or benefit. The entire Mississippi Valley and the shipping interests of the Great Lakes will be equally affected by it.

The chief injury is probably done to the eminent engineer whose name was everywhere here mentioned in connection with the proposed appointment to the office of Commissioner of Waterways, and to whom you slightingly refer as the "political engineer." This gentleman was Lyman E. Cooley, who, as you know, has twice been President of the Western Society of Engineers, who stands pre-eminently in the fore-front of the profession on waterway questions, and who, on account of his long official connection with the Chicago Sanitary and Ship Canal, is rendered especially fitted for such a position. The newspapers of Chicago and of the state at large everywhere mentioned his name in connection with the appointment, and it could hardly have escaped the knowledge of the writer of the editorial in question. I am, sir, yours truly,

Ebin J. Ward.

Marseilles, Ill., July 18, 1895.

(We have answered this letter in our editorial columns.—Ed.)

ELASTIC LIMIT IN STEEL.

Sir: Mr. Cunningham's statement in your issue of July 4, 1895, that "an apparatus for determining the true elastic limit is not a part of an inspector's outfit" is one that should not be allowed to stand without challenge.

It is true that inspection, as a rule, is nowadays so superficial that no inspector provides himself with even the simplest apparatus for observing the elastic limit. The further statement "that neither is one furnished by the mill" is certainly incorrect, because every mill-testing laboratory is provided with a pair of dividers, which is really all that is necessary to locate the elastic limit accurately. In my practice I have improved the ordinary dividers just one little bit by attaching an ordinary magnifying glass to one of the legs, and by this very minute elongations can be noted definitely. Further, by marking a few parallel scratches on the glass a definite amount of extension could be readily fixed upon. Hence, merely making a fine prick-punch mark for the free leg of the dividers, and a fine line on the chalked surface of the test-piece and holding it in position, merely keeping the eye on the glass, would locate the elastic limit with great precision.

It is rather strange that a firm doing as much inspection as that of Stowell & Cunningham should never observe the elastic limit, but depend entirely on the drop of the beam for the determination of the "yield point," a term in universal use in Great Britain and the continent of Europe.

Mr. Cunningham admits that this point, which he calls the "scale beam elastic limit" (see his letter of July 4) "is a function of the speed of the testing machine," but tries to save himself by the qualifying clause: "I do not permit any unusual proceeding in taking it." He fails to state, as Mr. Webster does very accurately in his letter of the same date, "that the inspector generally has all he can attend to in putting down his measurements and using the slide rule."

In my experience I have found that all of those inspectors who have "inherited the term elastic limit from their predecessors," as Mr. Cunningham puts it, never make themselves any observations of the elastic limit, invariably taking the figure announced by the operator of the testing machine as correct, and never checking the same in any manner themselves, being busy with their records. In view of the fact that Mr. Cunningham states that "the elastic limit is one of the most important functions of the steel itself," I wish to ask why he fails absolutely to make most careful observations of it, and why does he note the yield point instead? It is well known that the difference between the elastic limit and the yield point becomes greater and greater as the material becomes softer, while they are almost the same in very high steels. In extended series of tests of steel which I have made the records of which are available, both points were carefully noted in each and every test, and these show that in 80,000-lb. open-hearth steels, using test pieces of ½ in. cross-section, there was a variation of about 2,500 lbs. per sq. in. between the two. In the case of 70,000-lb. steel the difference was generally about 3,000 lbs. per sq. in. In later tests of 60,000-lb. steel I have found this difference to be as great as 3,500 lbs. per sq. in., and the very soft steels show still more marked differences. These observations of elastic limit need not delay the test one second if properly made by a competent observer as indicated above, and there can be no valid excuse for not observing and recording them. None of the finer instruments for determining the elastic curve of materials are essential in observations of the elastic limit, and the inspector's kit which cannot show even a good pair of dividers for this purpose must indeed be a sorry affair.

Mr. Webster's able exposition of how testing is habitually done nowadays should be carefully read by all engineers. They will learn from it that the looseness of present testing practices is the principal reason why engineers prescribe elastic limits so high that they are not actually attainable.

Mr. Cunningham's reply to Mr. Webster is also misleading in regard to the results obtained on full-size eyebars, in which he lays stress on the fact that the readings were obtained by a mercurial gage, which he says "is considered, by most people, to be the most reliable and accurate that we have."

Nothing can be further from the truth. Mr. Cunningham should have corrected these results by the variable frictional resistances in the testing machine, which are different for different pressures, and may amount to from 6 to 16% of the total readings indicated. The gage itself may be correct, but that does not provide for variations in the piston and piston rod frictions. In my investigations of testing machines I have found that, while the error of gage reading (not gage) under a load of 280,000 lbs. was about 6%, it became 8½% at a total load of about 464,000 lbs. Hence, making these corrections in the case of the 8 × 1-in. bar the actual corrected elastic limit would be 37,130, the ultimate strength would be 63,120, and hence the elastic ratio would apparently become 58.8% instead of 56.8, as stated. But, knowing that the figure 37,100 is the yield point and not the elastic limit, as reported, it is safe to deduct 3,000 lbs., leaving 34,100 lbs. as true elastic limit, or an actual elastic ratio of 54%, which is about correct.

Reporting tests in this manner, failing to state the corrections to be applied, has led to many popular fallacies. Has Mr. Cunningham ever tested the machine on which he has observed the results he gives as correct? I believe that he has never done this, because he admits that his kit does not contain an apparatus for measuring minute changes of length, without which the test cannot be made.

It is unfortunate that some engineers are apt to accept the apparent results of tests without taking sufficient pains to verify the accuracy of the apparatus, assuming that because a machine is in daily use it must of necessity be correct.

Gus C. Henning.

Temple Court, New York city, July 15, 1895.

(We have taken up the matter discussed by Mr. Henning, in connection with the other letters which have brought out his communication, in our editorial columns. We have also asked him to define the terms "elastic limit" and "yield-point" as he understands them, and append his reply as follows.—Ed.):

Sir: As long ago as 1865 the late Prof. J. Bauschinger re-adopted the definition of "elastic limit" as that point at which the "proportionality of strain to stress ceases," and clearly defined that point at which any further addition of stress causes marked permanent set as the "yield-point" (Streckgrenze). In all his famous investigations of cements, stone, wood and metal he has observed both points, which are clearly indicated by the changes in the curves of the plotted results. He pointed out the variability of the elastic limit, under repeated stress, variously applied stress, temperature, etc., and also showed the unreliability of observations of the yield point, which depended entirely upon the judgment and manipulations of the operator (manipulator?) of the testing machine. In papers III., IV. and V. of his "Mitthellungen," he describes his apparatus for making minute measurements in detail, explains his methods of determining the elastic limit and the modulus of elasticity, and leaves no doubt about the location or meaning of either the elastic limit or the yield point.

This seemed so fundamental and elementary to him, having been clearly defined by scientific writers on the elastic theory before him, that in his later work he never again referred to it, taking for granted that there could be no further question about it. In all his published work the figures for elastic limit mean that, and never the yield-point which is so often given by careless and unknowing observers.

Unwin, in his famous book, "The Testing of Materials of Construction," p. 6, says:

4. Limits of Elasticity.—Certain materials, like cast iron, are not perfectly elastic in their initial condition for any straining action. They are permanently deformed or take a permanent set with very small loads. But many materials are almost perfectly elastic, and most important materials of construction become so for a certain range of stress. It is only within that range of stress that ordinary rules of strength of materials are applicable. The limits of elasticity must be known to determine the extent to which the rules can be trusted.

He adopts the definition that the "elastic limit" is that point at which "the proportionality of strain to stress ceases," which was originally proposed by Euler, and re-adopted by many others after him.

Prof. A. B. W. Kennedy, always having used a lever machine and no other, proposed calling that load at which the lever drops "the elastic limit." But his measuring instruments were and are very crude, so that he never could have determined the elastic limit as it was defined and observed, long before he ever made any tests. Unwin declares, p. 256, par. 110:

The only definition which agrees with the theoretical conception of an elastic limit, and which is practically available in testing, is that which makes the elastic limit to be the stress at which proportionality between stresses and strains first visibly ceases when measurements of considerable delicacy are made.

Bauschinger has re-adopted this definition, and it is to his observations that we must look for any knowledge of the elastic limit as thus defined.

On p. 10, par. 6, Unwin thus treats of "The Yield Point:"

Iron and steel, and perhaps other rolled or hammered materials, at a stress exceeding more or less the elastic limit, there occurs a large and almost sudden increase of deformation in the ordinary method of testing, and the deformation is permanent or plastic deformation. The point at which this almost sudden augmentation of plastic deformation occurs is termed the yield, or breaking-down point.

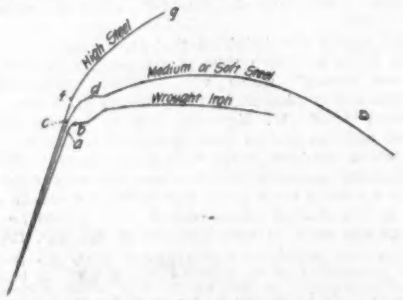
Prof. Unwin's further statements in this paragraph

are well worthy of study by many of our so-called "inspectors." It will show them that "yield-point" is a term as well-defined, understood and used as is "elastic limit," wherever claim can be made to careful, accurate and conscientious work. Unwin points out that the yield-point plays no part in deflection or distortion of structures, and that failure occurs immediately after elastic distortion, and therefore questions the propriety of determining this rather than the elastic limit.

In my opinion the elastic limit should be defined as "that stress at which the limit of proportionality to strain ceases," and that this point should always be carefully observed.

The yield-point is that point "at which any further increase of stress produces nothing but permanent strain (change of shape), and depends upon the manipulator, the inertia of the testing machine, the speed at which it is operated, and other incidental conditions."

The annexed diagram shows three approximate stress-strain diagrams, of wrought iron, medium and high steels, and shows most clearly the difference in the several terms.



A, c and f are points of elastic limit; b and d are the yield-points. In the high steel the elastic limit alone can be determined; there will be no "drop of the beam," and its yield-point may be located at the pleasure of the operator anywhere between f and g. There are a number of materials in which the yield point cannot be determined. Stone and cements have distinct elastic limits, but no yield-points.

New York, July 20, 1895. Gus. C. Henning.

Cast-welded joints on the Falk system are being used to form continuous rails on the Perrysville Ave. branch of the Pleasant Valley R. R., at Pittsburg, Pa. The system was described in our issue of March 21.

The production of pig iron during the first half of this year is reported by the American Iron & Steel Association at 4,087,558 gross tons, as compared with 2,717,983 tons and 3,939,405 tons during the first and second half respectively of 1894. Gains were made in Pennsylvania, Ohio and Alabama, while the production fell off in Illinois, Colorado and Virginia.

It is expected that steps will at once be taken for the further sanitary protection of Hemlock Lake, from which Rochester draws its water supply. A recent legislative act provides for the appointment of three commissioners, with power to condemn and acquire the whole shore front of the lake to a distance of 200 ft. back from the edge of the water. Messrs. Ira L. Otis, a manufacturer; Chas. T. Chapin, President of the Rochester Car Wheel Works, and S. Wile, a lawyer, have been appointed commissioners.

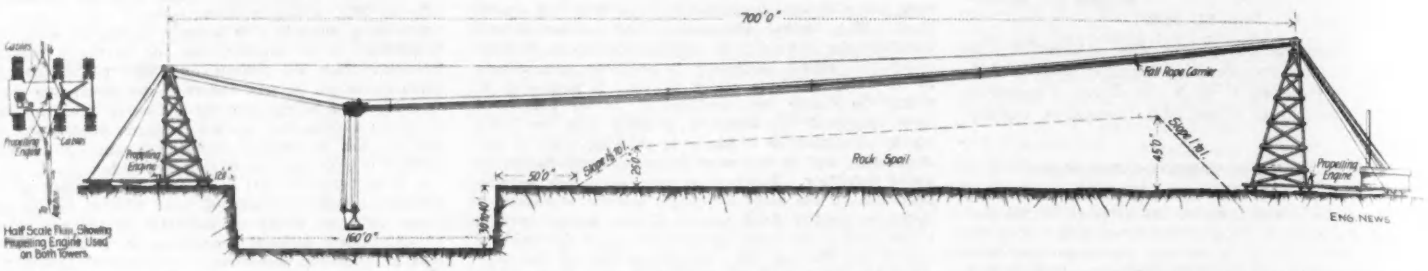


FIG. 39. GENERAL ELEVATION OF LIDGERWOOD TRAVELING CABLEWAY USED TO HANDLE ROCK ON THE CHICAGO DRAINAGE CHANNEL
The Lidgerwood Mfg. Co., New York, N. Y., Builders.

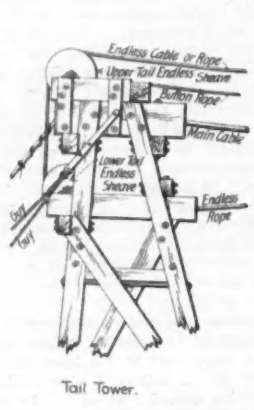


Fig. 40. Details of Top of Tail Tower.

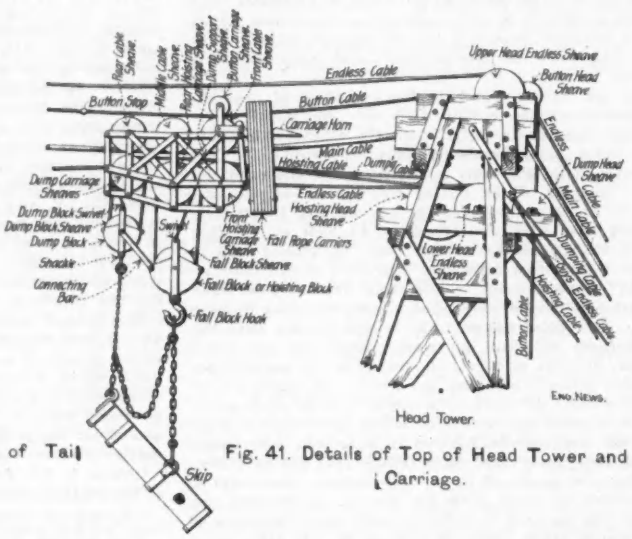


Fig. 41. Details of Top of Head Tower and Carriage.

CHICAGO MAIN DRAINAGE CHANNEL.

X.

Lidgerwood Traveling Cableways.

One of the devices most extensively used on the Chicago drainage channel for handling solid rock is the Lidgerwood traveling cableway, 19 of these machines altogether being employed on the work. The use of this device on so large a scale, and the various modifications which the traveling feature and the peculiarities of the work have necessitated, make a somewhat extended description necessary. The Lidgerwood fixed cableway is well known to engineers, but the adaptation of this system, and so far as we know, of any modern cableway system, and curiously enough the patent drawings show it applied to canal work. It is not known that this device was ever used, and, so until there is evidence to the contrary, we are justified in assuming that the first extensive use of the traveling cableway was on the Chicago drainage channel.

The Lidgerwood traveling cableway is used on seven different sections of the canal, and the main dimensions of the different cableways and the number used on each section are as follows:

Secs.	No. used.	Span, ft.	Height towers, ft.
2	2	643 & 576	93, both
3	4	700	93 and 73
4	2	650	" " "
5	1	700	" " "
6	4	725	93, both
7	1	657	93 and 73
8	4	700	" " "
8	1	550	83, both

These cableways are used, of course, merely to convey the rock from the pit to the spoil bank, after it has been blasted and loaded into skips. Two conditions were to be satisfied in performing this work: (1) to move the cableway along the canal easily and expeditiously, and (2) to pick up, carry away and dump the load as quickly and cheaply as possible. Ordinarily, where cableways had previously been used, the load was of value, and was to be conveyed from one place to another place where it was wanted for some useful purpose. Here, on the contrary, the load was of no value and the point to be gained was to get rid of it in the cheapest manner. The usual method of lowering the loaded skip to the ground and unloading by hand was therefore not economical, and the aerial dump (Fig. 44) was devised. This method of dumping the skips in the air and "on the fly," so to speak, has contributed largely to make the cableway an economical device for handling rock on the canal.

Turning now to the consideration of the traveling cableway, as manufactured by the Lidgerwood Mfg. Co., of New York, N. Y., for the Chicago drainage channel work: Fig. 39 shows a general elevation of one of the 700-ft. span cableways extending over the canal excavation and spoil bank as it is located in actual work. It will be noticed that the traveling feature consists simply in mounting the towers—which are firmly anchored to the ground in the ordinary fixed cableway—on cars running on a series of tracks and providing suitable mechan-

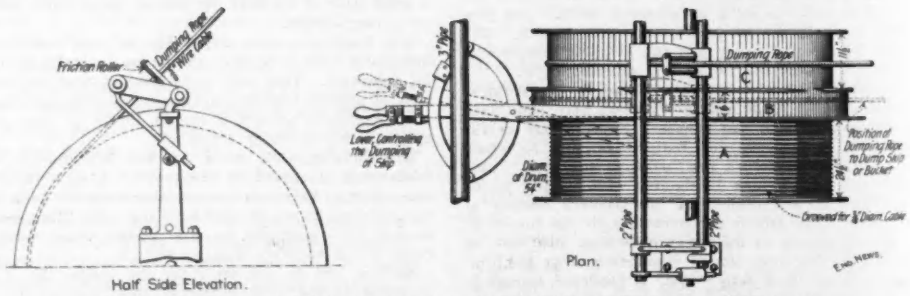


FIG. 42. LOCHER AERIAL DUMP, LIDGERWOOD TRAVELING CABLEWAY.

ism for propelling the cars. The gage of the tracks and the various dimensions of the towers, cars, etc., are clearly shown in the drawing.

The towers and cars are of simple framed construction in wood, properly counterweighted and built sufficiently strong to withstand the pull of the tractors for Sections 6, 7, 8, 11, 12 and 13. Fig. 42 shows the construction and operation of this dump. The drums A and C are of the same diameter, and are for the hoisting rope and dumping rope, respectively. Between them is the larger drum, B. The dumping rope comes from the top

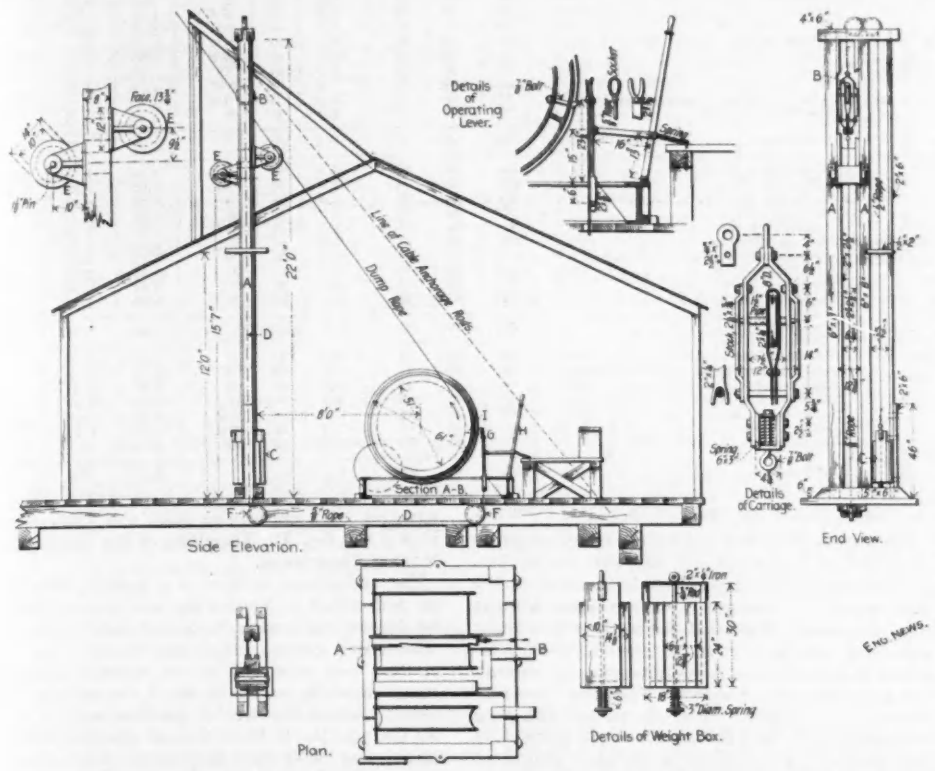


FIG. 43. MULLINIX AERIAL DUMP, LIDGERWOOD TRAVELING CABLEWAY.

cables. Figs. 40 and 41 show the arrangement of the sheaves and cables at the tops of the head and tail towers, respectively, and also the construction of the carriage and skip. The head tower is the one beneath which the hoisting engine for furnishing power for operating the plant is located, and the tail tower is a support for the opposite ends of the cables. As will be seen, there are in all five cables used in operating the carriage and skip—viz., the main cable for carrying the carriage; the traversing or endless cable for hauling the carriage; the hoisting cable for raising and lowering the load; the dumping cable for dumping the load, and the button cable for distributing and supporting the fall rope carriers. Of these cables only the dumping cable is peculiar to the traveling cableway as used on the canal, and is the only one whose function and operation need to be described in any detail. The main cable is made of crucible steel, and is 2¼ ins. in diameter with a hemp center. Its breaking load is 155 tons. As stretched between the towers this cable has a sag of 5 ft. per 100 ft. The traversing and hoisting cables are ¾ in. in diameter, and the button cable is ⅝ in. in diameter.

The duty of the dumping rope is to dump the skip in mid-aid. It is attached to a fall block, which in turn is attached to the rear end of the skip by a suitable chain and hook, and extends thence to the dump sheave at the top of the tower, and thence to the engine drum. As the dumping rope and hoisting rope are wound on the same drum, it will be seen that all their motions coincide in direction and character. It will be seen also that by winding the dumping rope temporarily at a higher speed than the hoisting rope, the rear end of the skip will be raised and the load will slide out of the front end. This is exactly what is done.

Two devices have been designed by which this temporary increase in the speed of the dumping rope can be secured. The older of these, and the one used on all but four of the cableways on the canal is the Locher aerial dump, invented by Mr. Chas. H. Locher, of the firm of Mason, Hoge & Co., contractors for Sections 6, 7, 8, 11, 12 and 13. Fig. 42 shows the construction and operation of this dump. The drums A and C are of the same diameter, and are for the hoisting rope and dumping rope, respectively. Between them is the larger drum, B. The dumping rope comes from the top of the tower passes between two friction rollers, D, carried by a frame which slides on the rods E E. The lever F is used to slide the friction roller frame backward and forward. The full lines show the normal positions of the lever, frame and dumping rope. To dump, the lever is thrown into the position shown by the broken lines, bringing the frame and rope over the drum B, which, being of a greater diameter than drum A, causes the dumping rope to travel at a higher speed than the hoisting rope, and therefore the skip to dump its load as just explained. It will be noticed that with this device the load can be dumped on one side of the canal only without a change in the machinery.

The second aerial device mentioned is somewhat more complicated and cumbersome in its operation and application, but it enables the skip to be dumped on either side of the canal at will without changing the machinery. This dump was designed by Mr. A. M. Mullinix, Superintendent for Gilman & Co., contractors for Section 3, and is used on the four cableways on that section only. The operation of the device is shown in Fig. 43. Two vertical ways, A A, are placed as shown in the section of the power house. Between these ways slides a carriage, B. Normally this carriage is held near the tops of the ways by the counterweight, C. To the bottom of the carriage is attached the rope, D D. Now, as the dumping rope passes over the fixed sheaves E E, it will be seen that if the carriage B is hauled down toward the bottom of the ways a loop is taken in the rope, which means that temporarily the dumping rope travels faster than the hoisting rope, and the skip is dumped. To haul the carriage down the ways the rope D D is used. This rope, as will be seen, passes under the sheaves F F, and to the placer G operated by the lever H, and has a loop at its top end, which when thrust forward catches onto the hook I and winds around the drum. As soon as the load is dumped, the drum is of course reversed, and the loop and carriage are hauled back to their normal positions by the counterweight.

The foregoing description, with the illustrations, will give a fair general idea of the operation and construction of the two aerial dumping devices, and various other parts of the cableway. The power machinery by which the dumping, hoisting, etc., are done, is all very simple, consisting merely of a 70-HP. boiler and 10 × 12-in. hoisting engine. For propelling the cableway along the canal a small reversible hoisting engine is placed on each car, which operates the system of blocks, as shown in the plan of the tail tower, Fig. 40. Simply by reversing the engine the car can be hauled backward and forward at will. The hoisting machinery gives the skip a hoisting speed of about 250 ft. per minute, and the carriage a traveling speed of approximately 1,000 ft. per minute. The total weight of the cableway, cars, skips and all, complete, is about 450,000 lbs., and its total cost about $14,000.

The method of working the cableways is the same in its general features for all sections on which they are used, but of course the details of operation differ on different sections. In the same way the cost of operation and capacity of the various machines differ accordingly as the management and superintendence are good or bad, with the hardness of the rock, etc. For these reasons, only the general methods of operation common to all sections will be described here; the various minor details peculiar to each section being described in the article on that section.

The work is usually done on a face about 12 ft. high, the stone being broken up by drilling a series of holes from the top down, transversely across the canal and parallel to the face, and blasting the rock out from the face. The skips are strung across the canal at the foot of the face and loaded with the broken rock by hand. The larger pieces of rock are chained out without being loaded into the skips. Considerable stress is laid upon this feature by the manufacturers, as it saves the time, labor and material that would otherwise be required to break the large rocks so that they can be carried by the skips. Stones weighing from six to eight tons can be handled in this way without injury to the cableway.

As an indication of this ability to handle large

Fig. 44. Dumping a Skip While in Motion.

rocks, the dimensions of a stone found by the writer in a cableway spoil bank are given—viz., 7½ × 4 × 3½ ft., which equals 105 cu. ft., or 3.9 cu. yds., and gives a weight of approximately 16,800 lbs.

The danger from chaining large rocks is very little, since they can be handled horizontally at any height

desired, and consequently if the chain does slip little damage is done. Moreover, the general practice is to do this handling of heavy pieces during the noon hour when all but three or four men are away, so that when the men return only fine material remains to be handled, and the skips can be loaded without delay to handle large rocks.

These skips are simple in construction. They are made of boiler plate steel, and are about 7 × 7 × 2 ft. deep, and weigh empty about 2,300 lbs. Their capacity is about 1.9 cu. yds. of rock in place.

The force required to operate the cableway proper consists of an engineman, fireman, signalman and generally a rigger, whose duty it is to attend to the oiling, changing of worn-out sheaves, etc. Sometimes one rigger has charge of two or more machines. Of course, the wages of these men vary somewhat, but as a general thing the aggregate wages of the engineman, fireman and signalman together amount to about $5.50 per 10-hour day. The rigger usually gets from $2 to $2.50 per day. The other items of expense entering into the operation of the cableways vary, of course, on each section, and so far as possible they will be given in the articles on the different sections. For a similar reason it is not possible to give any definite figures regarding the capacity of the cableways to handle rock, which are of general application. It may be said, however, that the amount handled per 10-hour shift is shown by the monthly progress reports of the Superintendent of Construction to run all the way from 200 cu. yds. to 500 cu. yds. The manufacturers set 500 cu. yds. per 10 hours as good work, with good superintendence and conditions similar to those on the canal. A full analysis of these conditions and the results of the work on the different sections will be given in future articles.

For aid in securing the information from which this article has been prepared, we are indebted to the Lidgerwood Mfg. Co., of New York, N. Y., and also very largely to Mr. Wm. M. Christie, Engineer, Qualey Cons. Co., Sag Bridge, Ill., and formerly of the engineer corps of the Sanitary District of Chicago.

WEATHER TABLE FOR JUNE, 1895. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Deg. Fahr.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Max.	Direction at time of max. velocity.	Precipitation—rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	66.2	90	41	49	7.0	36	N	2.11	0.81	9
	Portland, Me.	63.6	92	48	44	6.6	32	NW	1.97	0.66	15
	New York, N. Y.	70.0	95	52	43	9.7	40	NW	2.37	0.86	12
	Pittsburg, Pa.	74.7	98	50	48	5.3	22	NW	3.26	0.84	8
	Chicago, Ill.	70.2	95	50	45	13.7	40	NW	1.79	0.60	7
	Omaha, Neb.	70.4	92	48	44	7.7	27	SE	4.31	1.25	11
	St. Paul, Minn.	66.9	85	45	40	7.4	32	SW	4.18	1.20	14
	Duluth, Minn.	57.4	84	44	40	8 4	45	NW	4.62	1.07	21
	Bismarck, N. Dak.	69 4	88	39	49	8.8	46	S	4.01	1.87	16
	Average	66.5	91	46	45	8.3	36		3.09	1.02	12
Southern Cities.	Washington, D. C.	74.6	98	53	45	5.4	38	NW	4.34	1.85	12
	Louisville, Ky.	77.2	100	56	44	5.9	27	SW	4.94	2.66	10
	St. Louis, Mo.	77.1	96	60	36	8.8	48	W	2.46	0.97	12
	Savannah, Ga.	79.4	98	62	36	7.0	35	S	6.08	3.19	9
	Kansas City, Mo.	73.0	91	54	37	8.3	38	NW	7.72	3.72	11
	Jacksonville, Fla.	80.2	96	62	34	6.9	50	SE	4 98	2.23	12
	Chattanooga, Tenn.	75.9	97	56	41	4 9	60	W	5.69	1.75	9
	New Orleans, La.	80.4	93	68	25	6.5	30	N	9.74	2.10	20
	Memphis, Tenn.	78.7	98	60	38	5.7	22	SE	2.31	0.86	10
	Palestine, Tex.	78.2	92	62	30	5.6	32	N	5 29	1.18	11
	Average	77.5	96	59	37	6.5	38		5.36	2.11	12
Western Cities.	Helena, Mont.	56.6	89	35	54	8.7	42	N	1.30	0.27	11
	Port Angeles, Wash.	54.3	82	40	42	7.7	28	W	0.19	0.12	4
	San Francisco, Cal.	58.7	86	48	38	14.3	40	W	0.00	0.00	0
	Salt Lake City, Utah	63.5	90	38	52	6.3	34	S	0.99	0.70	6
	Santa Fe, N. Mex.	62.8	80	39	41	7.2	38	SW	3.99	0.41	9
	Denver, Colo.	61.8	90	40	50	7.3	24	NE	2.65	1.16	12
	Yuma, Ariz.	84.7	109	53	56	5.2	24	SE	T	T	0
	Average	63.2	89	42	48	8.1	34		0.87	0.38	6

APPLICATIONS OF THE NIAGARA POWER.

During the half-dozen years since the development of power at Niagara Falls was first undertaken, we have given our readers full information of the progress of the enterprise as its various features were developed. Now that the work is practically completed and the first of the great 5,000-HP. dynamos is in position and ready to generate current, our contemporary, "Cassier's Magazine," has undertaken a popular review of the entire work from its inception, and to it devotes the entire space of its July number. The number is profusely illustrated by half-tone engravings and portraits. The contributors include Messrs. Clemens Herschel, John Bogart and Albert H. Porter, of the Cataract Construction Co.'s engineering staff, and Prof. W. C. Unwin and Col. Th. Turrettini, of the International Niagara Commission.

The articles are written in a popular style, and are well suited to interest the non-technical reader. As far as engineering facts and figures are concerned, they contain little that has not from time to time been published in our columns, with the exception of the papers by Mr. L. B. Stillwell, Assistant General Manager of the Westinghouse Electric Co., and Mr. S. Dana Greene, Assistant General Manager of the General Electric Co., which describe the recent electrical work at Niagara. The former had under his charge the entire installation of electrical apparatus in the Niagara Power Station, and he fully describes the 5,000-HP. Tesla polyphase alternating current generator, with the various auxiliary electrical apparatus.

Mr. Greene's paper is on "The Distribution of Electric Energy," and he gives an account of what has already been done and what it is proposed to do in the distribution of the power made available by the Niagara Power Co.'s works. It appears that the only two manufacturing concerns which have actually closed contracts for the Niagara power, and built works to utilize it, are the Pittsburg Reduction Co. and the Carborundum Co. The former will take about 2,000 HP. for aluminum manufacture, and the latter about 1,000 HP. for its electric furnace, in which carborundum, a compound of silicon and carbon, is produced. The principal part of the paper is devoted to a discussion of the possibilities and probabilities of long distance power transmission.

In connection with this an interesting table of existing long distance electric power transmission plants is given, and we reprint it herewith in full.

Plants for the Long Distance Transmission of Power by Electricity.

From.	To.	Distance in miles.	HP.	Voltage. Generator.	Line.	Motor.	Remarks.
Lauffen	Frankfort, Germany	106	200	50	40,000	70	Three-phase alt. current plant for Exposition, 1892. Various experiments were made on this line.
Water power	Pachuca, Mexico	23	2,000	700	10,000	.....	Three-phase Gen. Elec. Co., under construction.
Water power	Milan, Italy	19	7,000	.....	.....	.....	Under construction.
Tivoli	Rome, Italy	18	9,000	.....	5,000	.....	Ganz system, in operation three years.
Water power	Guadalajara, Mexico	18	350	1,040	11,000	1,000	Three-phase G. E. Co., operated three years at 5,000 v. on line, last three months at 11,000 volts.
River Gorzente	Genoa, Italy	18	1,000	.....	8,000	.....	Ganz system.
Water power	Santa Rosalia, Mexico.	4½ 9½	20 20	2,500	2,500	.....	Three-phase G. E. Co., used in mining operations.
Water power	Gringesberg, Sweden	8	400	400	5,000	.....	In operation three years.
Lauffen	Heilbronn, Germany	7	200	50	5,000	100	Three-phase, in operation three years.
Richelieu River	St. Hyacinthe, Quebec.	5	450	2,500	2,500	.....	Three-phase G. E. Co.
Bielo Schwegar	Euchelm, Germany	4	75	2,900	2,900	120	Just completed.
Padenone	Fiume, Italy	3½	100	.....	3,000	.....	Ganz system.
Folsam	Sacramento, Cal.	20	3,000	800	11,500	1,000	Three-phase G. E. Co., alt. current, under construction.
Water power	Telluride, Colo.	15	1,000	5,000	5,000	5,000	Single-phase Westinghouse, in operation four years.
Water power	Lowell, Mass.	9&14	400	365	5,000	550D.C.	Three-phase G. E. Co., under construction. Operates St. R. R. by rotary converters.
Oregon City	Portland, Ore.	11	10,000	6,000	6,000	133	Ditto.
Mill Creek	Redlands, Cal.	7½	300	2,500	2,500	.....	Three-phase G. E. Co., in operation 1½ years.
San Antonio Canyon.	San Antonio, Cal.	7	800	.....	10,000	1,000	Single-phase Westinghouse.
Baltic	Taftville, Conn.	4½	400	2,500	2,500	2,500	Three-phase G. E. Co., in operation one year.
Sewells Falls	Concord, N. H.	4	400	2,200	2,200	.....	Ditto.
Water power	Walla Walla, Wash.	4	100	2,000	2,000	2,000	Single-phase G. E. Co., syn. motor.
Water power	Canandaigua, N. Y.	3½	100	2,080	2,080	2,000	Three-phase G. E. Co., under construction.
Water power	Pelzer, S. C.	3	1,500	3,300	3,300	3,300	Ditto.
Water power	Silverton, Colo.	3	125	2,300	2,300	2,000	Three-phase G. E. Co., running three months.
Water power	Bel Air, Md.	3	75	2,200	2,200	2,000	Ditto.
Water power	Hartford, Conn.	11	300	800	7,000	800	Three-phase G. E. Co., operates station by syn. motor.
Water power	Columbia Cotton Mills, Columbia, S. C.	¼	1,340	600	600	550	Three-phase G. E. Co., power distributed by 18 induc. motors.
San Antonio, Cal., U. S.	Pomona, Cal.	15	150	1,000	10,000	1,000	Single-phase Westinghouse, operates lights in Pomona.
Water power	Anderson, S. C.	7	150	5,500	5,500	1,000	Two-phase Stanley Co., operates incandescent lights and induction motors.
Water power	Mine at Bodie, Cal.	13	150	3,500	3,500	3,300	Single-phase Westinghouse, synchronous motor.
	Total,		44,105 HP.				

Electric towing has been in successful operation in France since July, 1893, on the summit level of the Burgundy Canal, along a reach of about three miles, of which about two miles is tunnel. The width of the waterway is 20 ft. in the tunnel and 23 ft. in the open part, and as there is only room for one boat at a time, the trains of boats are despatched alternately from each end. The depth is 7 ft. 6 ins. The plant consists of turbines at the locks at each end of the summit level working dynamos, with a wire carrying the circuit between them. From this the motor on the towboat takes the current. A fall of 23 ft. from the level is sufficient with the quantity of water available to give 20 HP. at one end and 15 HP. at the other, or 35 HP. together, about half of which is utilized on the tug boat. The boat is 50 ft. long, 10½ ft. wide, 4 ft. deep, and 18 ins. draft, and is built of iron, the machinery being housed in the center. The electric apparatus weighs about one ton, and the boat is lighted by electricity when in the tunnel. The speed varies from 1½ to 3 miles an hour, according to the load. The motor is calculated to give on the chain a tension of 2,640 lbs. The total cost of this electric installation was $27,800.

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PERSONALS.

Mr. B. R. Felton, City Engineer of Marlborough, Mass., has resigned.

Mr. Otis Osgood, civil engineer and surveyor, died at Lowell, Mass., July 19.

Mr. Simeon Hunter has been appointed Superintendent of Water Works at Ashland, O.

Mr. Joseph A. Hunkele has resigned his position as Superintendent of Street Cleaning at Newark, N. J.

Mr. J. K. MacDonald has been appointed City Engineer of Dunkirk, N. Y., succeeding Mr. John M. Hackett.

Messrs. George Dickey, Augustus E. Christie and Dr. E. H. Maynard have been appointed Water Commissioners of Nyack, N. Y.

Mr. George W. Bishop has been appointed a member of the Railroad Commission of Massachusetts, in place of the late Mr. E. A. Stevens.

Mr. Nisbet Wingfield, M. Am. Soc. C. E., has moved from Chattanooga, Tenn., to Atlanta, Ga., and has opened offices in the Norcross Building.

Mr. Charles E. A. Jacobson, Engineer of the Water Department of Newark, N. J., has been relieved from duty by the Board of Works, he having declined to resign.

Mr. Miller has resigned his position as City Engineer of New Castle, Pa., which position he has held for ten years. It is understood that he intends to go into business for himself.

Mr. P. F. Brendlinger, M. Am Soc. C. E., of Yonkers, N. Y., has been appointed Chief Engineer of the Dunderberg Mountain Gravity R. R. This road was described in our issue of Dec. 21, 1889.

Mr. Wm. H. Pike, Jr., long connected with the Brady Mfg. Co., of Brooklyn, N. Y., and who has been its Superintendent for the last two years, has resigned his position with that company.

Mr. C. A. Allen, M. Am. Soc. C. E., of Worcester, Mass., has been appointed one of the commissioners in a grade-crossing case between Southboro, Mass., and the New York, New Haven & Hartford R. R.

Mr. Edward L. Norfolk, an engineer, architect and contractor, who died recently at Kingston, Mass., was born in Salem in 1815. Among his works were a ropewalk at Memphis, Tenn., and a large mill at Newburyport, Mass.

Mr. Oluf Tyberg, M. E., well known as the designer of many automatic and other labor-saving machines, has recently acquired an interest in the Brady Mfg. Co., and has accepted the position of Superintendent of the factory of that concern at 83 Washington St., Brooklyn, N. Y.

Mr. Frederick S. Massey, of Brooklyn, N. Y., died in that city July 19, at the age of 55. He was born at Watertown, N. Y., was at one time President of the Rome, Watertown & Ogdensburg R. R., and in 1879 was appointed President of the Board of Public Works of Brooklyn.

Messrs. M. P. Mason, G. D. Hewitt, Philip Hull and Scott M. Gibb, of Carthage, N. Y., have been chosen Water Commissioners for the village of West Carthage. Dr. G. D. Hewitt has been elected chairman of the board, and Mr. M. P. Mason has been appointed to secure plans for a water supply.

Mr. George Thomas, McLauthlin, mechanical engineer, of Boston, doing business under the firm name of George T. McLauthlin & Co., died July 20 at Gaysville, Vt. He was born at Duxbury, Mass., in 1826, and after being engaged in the manufacture of boots and shoes, undertook the manufacture of water wheels and machinery.

Mr. Henry B. Seaman, M. Am. Soc. C. E., who has for four years past been in charge of the improvements of the New York, New Haven & Hartford R. R. at Mount Vernon, N. Y., has been admitted to the bar in the state of New York. Experience of the many legal difficulties arising on contract work led to Mr. Seaman taking up the study of law.

Mr. T. Kennard Thomson, Assoc. M. Am. Soc. C. E., has opened an office at Stamford, Conn., and will make a specialty of bridges, roofs, buildings, and railway construction. He has had ten years' experience in different branches of the profession in America and Europe, and during that time has held responsible positions with some of the leading railway and bridge companies, while during the last two years he has done considerable work as a consulting engineer.

Mr. Joseph H. Jenkins, who died at Winona, Minn., July 11, was born at Falmouth, Mass., in 1835, and graduated from Wesleyan University at Middletown, Conn. His railway experience commenced in Arkansas during the war, and he went to Minnesota in 1865. He was Assistant Chief Engineer of the Winona & St. Peter Ry., and later Assistant Superintendent, and he was for two years Superintendent of the La Crosse and Dubuque Division of the Chicago, Milwaukee & St. Paul Ry. Since 1883 he had devoted himself to private business.

Mr. Lewis B. Jackson has been appointed City Engineer of Chicago, Ill., vice Mr. S. B. Artingstall, resigned. He was at one time Superintendent of Construction of the Wabash R. R., and was Chief Engineer and Superintendent of Construction on the Louisville, New Albany & Chicago Ry.; Chief Engineer of the Chesapeake & Ohio Ry. for two years, and was in charge of the construction of 100 miles of the Texas & Pacific Ry. He was also Chief Engineer of the Elgin, Joliet & Eastern Ry. He is about 40 years of age, and has lived in Chicago for several years.

Mr. James Curran, who died at Baltimore, Md., July 19, at the age of 82, was appointed Engineer of the Baltimore Water-works in 1867 by Mayor Robert T. Banks, and while in that office he designed the iron work for the Gunpowder water supply. He also supervised the extension of the water mains called for during his term of office, and made many improvements in the water system, which are still in use. He also designed the plan by which the water mains are trapped without shutting off the pressure. The fire hydrants now in use are his design. In June, 1885, Mr. Curran resigned from the water department to become supervising inspector of steam vessels for this district. He was born in Philadelphia.

Col. Wm. L. Ludlow, U. S. A.; M. T. Endicott, U. S. N., and Mr. Alfred Noble, the members of the Nicaragua Canal Commission, arrived in New York on the U. S. S. "Montgomery" on July 21. The Commission landed at Greytown on May 13, and, after examining the harbor and proposed work in that vicinity, proceeded by boat up the San Juan and across Lake Nicaragua, and thence overland to Brito, the Pacific terminus of the canal. They then worked back over the line of the canal to Greytown again, occupying five weeks in this second examination, and working in a continuous rain during the latter part of their journey. They left Greytown on June 24 for a trip to San Jose, the capital of Costa Rica, and thence went, by way of Port Limon, to Colon and the Panama Canal. On July 9 they left Colon on the "Montgomery" for New York.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

ENGINEERING ASSOCIATION OF THE SOUTH.
Aug. 8. Secy., H. D. Ruhm, Nashville, Tenn.
AMER. ASS'N FOR THE ADVANCEMENT OF SCIENCE.
Aug. 28 to Sept. 7. At Springfield, Mass. Secy., F. W. Putnam, Salem, Mass. Local Secy., Wm. A. Webster, Springfield, Mass.
NEW ENGLAND WATER-WORKS ASSOCIATION.
Sept. 11 to 13. At Burlington, Vt. Secy., John C. Whitney, Newton, Mass.
NATIONAL IRRIGATION CONGRESS.
Sept. 16 to 19. At Albuquerque, N. Mex. Secy., Fred L. Alles, Los Angeles, Cal.
NEW ENGLAND ROADMASTERS' ASSOCIATION.
Sept. 18, 19. Secy., M. C. Hamilton, Hartford, Conn.
AMERICAN INSTITUTE OF MINING ENGINEERS.
Oct. 8. At Atlanta, Ga. Secy., R. W. Raymond, New York, N. Y.
ROADMASTERS' ASSOCIATION OF AMERICA.
Oct. 8. At St. Louis, Mo. Secy., W. W. Sharpe, Waycross, Ga.
AMERICAN INT. ASSOC. OF RY. SUPTS. OF BRIDGES AND BUILDINGS.
Oct. 15. At New Orleans, La. Secy., S. F. Patterson, Boston & Maine R. R.; Concord, N. H.
AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 15. At Montreal, Que. Pres., Joel Hurt, Atlanta, Ga.

NEW PUBLICATIONS.

SUMMER EXCURSION ROUTES.—Pennsylvania R. R. Co., J. R. Wood, General Passenger Agent, Philadelphia, Pa. 8vo; ornamental paper; pp. 205; illustrated.

This is a handsomely printed and illustrated directory of the various summer resorts reached by the Pennsylvania system and its connections. Besides outlining the several routes of travel to the different resorts, the excursion rates, hotel accommodations, etc., the local features of interest are briefly described and suggestions offered as to the best manner of visiting them. A noticeable feature is the carefully prepared index to the contents, a convenience much needed and not always found in publications of this character.

GENERAL SPECIFICATIONS FOR RAILWAY AND HIGHWAY BRIDGES, by the Osborn Co. (Frank C. Osborn and A. Lincoln Hyde), Cleveland, O. 8½ × 14 ins.

Three specifications are included in this set, as follows: (1) Bridge substructures, (2) Highway bridge superstructures, and (3) Railway bridge superstructures. Open-hearth acid steel is required for railway bridges, and either basic or acid open-hearth steel for highway bridges. The phosphorus in acid steel is limited to 0.08% and in basic steel to 0.04%. Soft steel is required for power-driven rivets, stiffener angles which are offset or bent, fillers, and lateral bracing. Medium steel is required for beams, channels, floor beams, truss members, pins and trestle legs. The physical qualities required are:

	Soft steel.	Medium steel.
Ultimate strength, lbs.	54,000 to 62,000	60,000 to 68,000
Elastic limit, lbs.	34,000	36,000
Elongation, per cent.	*25	*20
Reduc. of area at frac.	50	40

*26% and 24% for railway bridges.

As soon as practicable after rolling all metal is required to be given one coat of carbon primer. Inaccessible parts before riveting are to be given two coats of red lead, and all metal before leaving the shops receives one coat of such paint as the engineer requires.

TRADE PUBLICATIONS.

SHEFFIELD CAR COMPANY, Manufacturers of Light Cars for Railway Work and for Industrial Purposes. Three Rivers, Michigan, U. S. A. A Special Foreign Edition.

This is a handsomely illustrated pamphlet of 40 pages especially issued for foreign circulation, and each type of car is described in English, French, German, and Spanish. The leading styles of velocipede, hand and inspection cars are included, and the company will be pleased to forward this catalogue to all persons in foreign countries interested in light cars of any description.

TRENCH MACHINES.—Carson Trench Machine Co., Boston, Mass. Catalogue B. Paper; oblong, 9 × 6 ins.; pp. 34; illustrated.

This catalogue deals particularly with the Carson-Trainor trench machine, illustrated and described fully in our issue of June 20, the special feature of which is that the traveler from which the bucket is suspended runs on a rigid iron track supported by timber trestle bents, forming a continuous structure, instead of a suspended cable, as in the Carson-Lidgerwood cableway machine. The hoisting and traversing motions are all controlled by the engineman at the head of the trench.

WILLANS CENTRAL VALVE ENGINE.—M. C. Bullock Mfg. Co., Chicago, Ill. Paper, 7⅞ × 10 ins.; pp. 36; illustrated.

This is the third edition of the company's catalogue describing the well-known central valve, high-speed engine manufactured under the patents of Willans & Robinson, of England. The Bullock Mfg. Co. is the sole American manufacturer of these engines, and the catalogue shows a number of its engines direct coupled to American dynamos, and shows also some of the principal foreign electrical plants using the engines. In this engine, which was described and illustrated in our issue of March 9, 1889, the valves are vertical pistons moving inside the hollow piston rods.

CAR BUYER'S HELPER.—Brownell Car Co., St. Louis, Mo. Cloth, 6¼ × 9 ins.; pp. 172; illustrated.

While this book is intended, of course, to show the superiority of this company's street cars, it contains much useful information in regard to the design, construction and equipment of cars for cable and electric railways. One of the most important specialties is the "accelerator" car door, having double doors, the one next the near side of the platform being open, so that passengers can get in and out without crossing half the width of the platform to a door in the middle of the end. This arrangement is now in extensive use.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
July 26.	Water-works system,	Monticello, Ind.	July 11
	Advertised, Eng. News, July 11 and 18.		
July 26.	Post office building,	Richmond, Que.	July 11
July 26.	School buildings, etc. (3),	Buffalo, N. Y.	July 18
July 26.	Pipe sewers,	Rochester, N. Y.	July 18
July 26.	Fire engine house,	Rochester, N. Y.	July 18
July 26.	Water mains,	Rochester, N. Y.	July 18
July 26.	Brick paving, etc.,	Louisville, Ky.	July 18
July 27.	Pipe (182 tons of 14-in.),	Ithaca, N. Y.	July 18
	Advertised, Eng. News, July 18 and 25.		
July 27.	Water-works system,	Lockport, Ill.	July 18
July 27.	Street improvements,	Evanston, O.	July 18
July 27.	Water-works system,	Fowler, Ind.	July 18
	Advertised, Eng. News, July 18 and 25.		
July 27.	Boiler, etc.,	Erie, Pa.	July 18
July 27.	Pipe sewers,	Pittsburg, Pa.	July 18
July 27.	Brick culverts,	Pittsburg, Pa.	July 18
July 27.	Bridge,	Pittsburg, Pa.	July 18
July 27.	Sewage pumping station,	Ithaca, N. Y.	July 18
July 27.	Sewers (12,000 ft.),	Ithaca, N. Y.	July 18
July 27.	Old steel rails,	Ithaca, N. Y.	July 18
	Advertised, Eng. News, July 18 and 25.		
July 27.	Pumping engine,	Buffalo, N. Y.	July 18
July 27.	Bridges (2 contracts),	Hackensack, N. J.	July 25
July 27.	Pipe sewers,	Indianapolis, Ind.	July 25
July 27.	Trunk sewer (30,000 ft.),	Pittsburg, Pa.	July 25
July 27.	Steel smokestacks, etc.,	Pittsburg, Pa.	July 25
July 29.	Water-wks. system,	Momence, Ill.	July 4
	Advertised, Eng. News, July 4 to 25.		
July 29.	Cement (625 bbls.),	Cincinnati, O.	July 4
July 29.	Sewers,	Huntington, Ind.	July 11
July 29.	Artesian well,	Cambridge, Ill.	July 11
July 29.	Sewer pipe, etc.,	Washington, D. C.	July 18
	Advertised, Eng. News, July 18.		
July 29.	Brick paving,	Monroe, Mich.	July 18
July 29.	Asphalt paving,	New York, N. Y.	July 18
July 29.	Stand-pipe foundation,	Cincinnati, O.	July 18
July 29.	Lift bridge,	Brooklyn, N. Y.	July 18
	Advertised, Eng. News, July 18 and 25.		
July 29.	City hall, etc.,	Cohoes, N. Y.	July 18
July 29.	Water-wks. system,	New Prague, Minn.	July 18
July 29.	Water-wks. system,	Forrest, Ill.	July 18
July 29.	Improvement bonds,	Syracuse, N. Y.	July 25
July 29.	Pipe sewers,	Boston, Mass.	July 25
July 29.	Levee work,	Memphis, Tenn.	July 25
July 29.	Building improvements,	Brooklyn, N. Y.	July 25
July 29.	Water bonds ($18,000),	Milford, Mich.	July 25
July 29.	Laying water mains,	Chicago	July 25
July 30.	Court house plans,	Atchison, Kan.	July 4
July 30.	Library building plans,	Hoboken, N. J.	July 11
July 30.	Underground conduits,	Cincinnati, O.	July 11
July 30.	Court house plans,	Knoxville, Ia.	July 11
July 30.	Electric light bonds,	Riverside, Cal.	July 18
July 30.	Bridge,	Emmettsburg, Ia.	July 18
July 30.	Building and wall,	Brooklyn navy yard	July 18
July 30.	Asphalt paving,	Jersey City, N. J.	July 18
July 30.	Belgian block paving,	Jersey City, N. J.	July 18
July 30.	Dredging (463,000 cu. yds.),	Brooklyn	July 18
	Advertised, Eng. News, July 18 and 25.		
July 30.	Portland cement (8,000 bbls.),	New York.	July 18
July 30.	Electric light plant,	Ontonagon, Mich.	July 18
July 30.	Public building work,	Detroit, Mich.	July 18
July 30.	Brick sewers,	Syracuse, N. Y.	July 25
July 30.	Stone arch culvert,	Syracuse, N. Y.	July 25
July 30.	Sewer,	Trenton, N. J.	July 25
July 30.	Pipe sewers,	Troy, N. Y.	July 25
July 30.	Sewer,	Denver, Colo.	July 25
July 30.	Cement sidewalks,	Indianapolis, Ind.	July 25
July 30.	Street improvements,	Jamaica, N. Y.	July 25
July 30.	Grading,	Boston, Mass.	July 25
July 30.	Jail,	Salt Lake City, Utah	July 25
July 30.	Water-works supplies,	Jersey City, N. J.	July 25
July 30.	Bridge,	Jersey City, N. J.	July 25
July 30.	Water-works system,	Alden, Minn.	July 25
July 30.	School bldg. repairs,	Philadelphia, Pa.	July 25
July 31.	Artesian well,	Alvarado, Tex.	July 4
July 31.	Electric light equipment,	St. Clair, Pa.	July 11
July 31.	Sewers,	Waterbury, Conn.	July 18
July 31.	Reservoir work,	Washington, D. C.	July 18
	Advertised, Eng. News, July 18.		
July 31.	Brick paving,	New Castle, Pa.	July 18
July 31.	Elec. light plant bldg.,	Chicopee, Mass.	July 25
July 31.	Building,	Toronto, Ont.	July 25
July 31.	Plans for bridge,	Denver, Colo.	July 25
July 31.	Fire engine house,	Brooklyn, N. Y.	July 25
July 31.	Water-works system,	Orangeville, Ont.	July 25
July 31.	School building, etc.,	Baltimore, Md.	July 25
Aug. 1.	Water-wks. system,	Logan, O.	July 4
	Advertised, Eng. News, July 4 and 11.		
Aug. 1.	Water-wks. franchise,	West Rutland, Vt.	July 11
	Advertised, Eng. News, July 11 and 18.		
Aug. 1.	Armory at	Camden, N. J.	July 11
Aug. 1.	Granite block paving,	Mobile, Ala.	July 11
	Advertised, Eng. News, July 11 to 25.		
Aug. 1.	Steel bridge,	Ironton, O.	July 11
Aug. 1.	Electric lighting,	Shawano, Wis.	July 18
Aug. 1.	Plans for penitentiary,	Nashville, Tenn.	July 18
Aug. 1.	Fire engine house (3),	Louisville, Ky.	July 18
Aug. 1.	Sewers, Grossdale,	Ill.	July 18
Aug. 1.	Macadamizing, Grossdale,	Ill.	July 18
Aug. 1.	Water-works,	Shawang, Wis.	July 18
Aug. 1.	Tramway and derrick,	Detroit	July 18
Aug. 1.	Grading, Mount Carmel,	Pa.	July 25
Aug. 1.	Trunk sewers, etc.,	New York, N. Y.	July 25
Aug. 1.	Pipe sewer, New Kensington,	Pa.	July 25
Aug. 1.	Reservation bldgs.,	Niagara Falls, N. Y.	July 25
Aug. 1.	Street improvements,	New York, N. Y.	July 25
Aug. 1.	Brick paving,	Milwaukee, Wis.	July 25
Aug. 1.	Resurfacing streets,	Beverly, N. J.	July 25
Aug. 1.	Sewage pumping station,	Natick, Mass.	July 25
Aug. 1.	Ventilating, etc.,	Rock Island, Ill.	July 25
Aug. 1.	Electric lighting,	Trenton, Mo.	July 25
Aug. 1.	Electric lighting,	Ann Arbor, Mich.	July 25
Aug. 2.	Electric lighting,	El Paso, Tex.	May 23
Aug. 2.	Street improvements,	Richmond, Ind.	July 18
Aug. 2.	Sewers,	Cincinnati, O.	July 25
Aug. 2.	Plans for court house,	Paris, Tex.	July 25
Aug. 2.	Asphalt paving,	Brooklyn, N. Y.	July 25
Aug. 3.	Paving (14,000 sq. yds.),	Mansfield, O.	July 18
	Advertised, Eng. News, July 18 and 25.		
Aug. 3.	Iron bridge,	Cincinnati, O.	July 18
Aug. 3.	Brick paving,	Cincinnati, O.	July 18
Aug. 3.	Artesian well,	Bushnell, Ill.	July 18
	Advertised, Eng. News, July 18.		
Aug. 3.	Docks, piers, etc., at	Pinners' Pt., Va.	July 25
	Advertised, Eng. News, July 25.		
Aug. 3.	Car shop,	Peterboro, Ont.	July 25
Aug. 3.	Cast iron pipe,	Brooklyn, N. Y.	July 25
	Advertised, Eng. News, July 25.		
Aug. 3.	Sewers (12,500 ft.),	Indianapolis, Ind.	July 25
Aug. 3.	Steel drawbridge,	Hainesport, N. J.	July 25
	Advertised, Eng. News, July 25 and Aug. 1.		
Aug. 3.	Pipe sewers (22,300 ft.),	Ithaca, N. Y.	July 25
	Advertised, Eng. News, July 25.		
Aug. 3.	Bldg. foundations,	E. Cambridge, Mass.	July 25
Aug. 5.	Levee wk. (700,000 cu. yds.),	Rock Island.	July 11
	Advertised, Eng. News, July 11 to Aug. 1.		
Aug. 5.	Sewers, Orange,	N. J.	July 18
	Advertised, Eng. News, July 18 and 25.		
Aug. 5.	Pumping engine,	Jackson, Tenn.	July 18
Aug. 5.	Water-wks. system,	Morristown, Tenn.	July 18
Aug. 5.	Water-wks. system,	Schaller, Ia.	July 18
Aug. 5.	State house work,	Topeka, Kan.	July 18
Aug. 5.	Highway bridge,	Seattle, Wash.	July 18
Aug. 5.	Asphalt paving,	Syracuse, N. Y.	July 25
Aug. 5.	Sewers,	Crafton, Pa.	July 25
Aug. 5.	Schoolhouse,	Providence, R. I.	July 25
Aug. 5.	Sea wall at Fort Wayne,	Mich.	July 25
Aug. 5.	Water-works system,	Sellersville, Pa.	July 25
	Advertised, Eng. News, July 25 and Aug. 1.		
Aug. 5.	Electric lighting,	Dayton, Ky.	July 25
Aug. 5.	Bridge approaches,	Columbus, O.	July 25
Aug. 5.	Street improvements,	Streator, Ill.	July 25
Aug. 5.	Steel improvements,	Streator, Ill.	July 25
Aug. 5.	Paving,	Crafton, Pa.	July 25
Aug. 6.	Court house,	Dublin, Ga.	June 20
Aug. 6.	Main sewer,	Hammond, Ind.	July 18
Aug. 6.	Artesian well,	Jerseyville, Ill.	July 18
Aug. 6.	Paving,	Columbus, O.	July 25
Aug. 6.	Sewer, Mount Vernon,	N. Y.	July 25
Aug. 6.	Sewers,	Brooklyn, N. Y.	July 25
Aug. 6.	Jail,	Toulon, Ill.	July 25
Aug. 6.	Pipe, pig lead, etc.,	Washington, D. C.	July 25
Aug. 6.	Water-works system,	Alexandria, Ont.	July 25
	Advertised, Eng. News, July 25.		
Aug. 7.	Street improvement bonds,	Toledo, O.	July 18
Aug. 7.	Boiler house,	Cleveland, O.	July 18
Aug. 7.	Iron bridge,	Frankfort, Ind.	July 18
Aug. 8.	Water-wks. system,	Middleville, N. Y.	July 18
	Advertised, Eng. News, July 18 to Aug. 1.		
Aug. 8.	B'k pav'g (18,341 sq. yds.),	Marion, Ind.	July 25
Aug. 10.	Paving,	Springfield, Ill.	July 18
Aug. 10.	Brick hospital building,	Columbus, O.	July 25
Aug. 12.	Building addition,	Los Angeles, Cal.	June 27
Aug. 12.	Bridge, Rock Island,	Ill.	July 11
Aug. 12.	Electric wiring,	Dallas, Tex.	July 25
Aug. 12.	Plans, high school bldg.,	Providence	July 25
Aug. 12.	Plans for school bldg.,	Toledo, O.	July 25
Aug. 12.	Laying water pipe,	Knoxville, Ill.	July 25
	Advertised, Eng. News, July 25.		
Aug. 13.	Brick sewer,	Indianapolis, Ind.	July 18
	Advertised, Eng. News, July 18 and 25.		
Aug. 13.	Jail,	Houston, Tex.	July 18
Aug. 13.	Asphalt paving,	Indianapolis, Ind.	July 25
Aug. 13.	Public building,	Chester, Pa.	July 25
	Advertised, Eng. News, July 25 and Aug. 1.		
Aug. 14.	Asphalt paving,	Hoboken, N. J.	July 25
Aug. 15.	Brick paving,	Pontiac, Ill.	July 18
	Advertised, Eng. News, July 18 and 25.		
Aug. 15.	Water bonds ($200,000),	Cleveland, O.	July 18
Aug. 15.	Rebuilding pump. mach'ry,	Cleveland.	July 25
Aug. 16.	Plans for school building,	Buffalo, N. Y.	July 18
Aug. 16.	Brick paving,	Cincinnati, O.	July 25
Aug. 20.	Capitol building,	Olympia, Wash.	June 20
Aug. 20.	Water-wks. system,	Grand Junction, Col.	July 18
	Advertised, Eng. News, July 18 to Aug. 8.		
Aug. 20.	Steel highway bridge,	Warren, Pa.	July 25
	Advertised, Eng. News, July 25 and Aug. 1.		
Aug. 20.	Sewer system,	Logan, O.	July 25
	Advertised, Eng. News, July 25 and Aug. 1.		
Aug. 21.	Dredging in Indian River,	Fla.	July 25
	Advertised, Eng. News, July 25 to Aug. 15.		
Aug. 26.	Hospital buildings,	Bangor, Me.	July 25
Aug. 30.	Timber (60 sq. miles),	Ottawa, Ont.	July 11
Sept. 2.	Electric light plant,	Canton, Miss.	July 25
	Advertised, Eng. News, July 25 and Aug. 1.		
Sept. 2.	Water-works system,	Canton, Miss.	July 25
	Advertised, Eng. News, July 25 and Aug. 1.		
Sept. 2.	Water-works franchise,	Canton, Miss.	July 25
	Advertised, Eng. News, July 25 and Aug. 1.		
Sept. 6.	Court house,	South Bend, Ind.	July 25
Sept. 5.	State capitol plans,	St. Paul, Minn.	July 11
Sept. 10.	Plans for city hall,	Worcester, Mass.	July 18
Sept. 14.	Plans for library bldg.,	Madison, Wis.	July 18
Sept. 18.	Water-wks. franchise,	Butte, Mont.	July 11
	Advertised, Eng. News, July 11 to Aug. 8.		
Oct. 1	Plans for art building,	Philadelphia, Pa.	May 23
	Advertised, Eng. News, May 23 to June 27		
No date.	Asphalt paving,	Newark, N. J.	July 18
"	Granite paving, etc.,	Newark, N. J.	July 25
"	Extend. electric l't plant,	Easton, Md.	July 25
"	Arc lights,	Madisonville, Ky.	July 25

RAILWAYS.

East of Chicago.

CHICAGO, INDIANA & EASTERN.—It is stated that an additional extension of this railway is proposed from Muncie to Richmond, Ind., 36 miles. The road has been completed from Fairmont to Matthews, Ind., 10 miles, and is under contract from Fairmont to Converse, 18 miles, and from Matthews to Muncie, 15 miles, H. E. Drew, of Indianapolis, being the contractor. Secy., Walter C. Childs, Chicago; Ch. Engr., Fremont Wilson, Fairmont, Ind.

DEPEW & TONAWANDA.—The incorporation of this company was recently noted. The New York state board of railroad commissioners has granted authority for the construction of the road, which, it is stated, will be operated as a branch of the Lehigh Valley.

M'KEESPORT & BELLE VERNON.—Work has commenced on an extension from Belle Vernon, Pa., to Fayette City, 4 miles, to be completed Sept. 1. It is stated that an early extension is also contemplated up the Monongahela River into the West Virginia mineral and timber lands. The road is operated by the Pittsburg & Lake Erie.

PATTEN & SHERMAN.—Press reports quote A. A. Burleigh, Pres., Houlton, Me., as stating that the construction of this road, from the connection with the Bangor & Aroostook to Patten, will be begun at once. It is not the intention to let any contracts, but to have the work done by the company's own forces. The right of way has been secured and the road located from Sherman, Me., north to Patten, 10 miles.

TORONTO, HAMILTON & BUFFALO.—Geo. S. Good & Co., of Lock Haven, Pa., are said to have the contract for the grading, masonry, and tracklaying for the 40 miles of this railway from Hamilton, Ont., to Welland, Ont., as advertised in Engineering News, and they are now subletting the grading and masonry. About 35 miles of the line is team work, and about 5 miles heavy rock work. The work is to be finished by Dec. 1, 1895. Ch. Engr., E. B. Wingate.

Southern.

ADDISON & PICKENS.—It is stated that the grading of this road from Addison to Pickens, W. Va., 27 miles, will be commenced this month. Geo. M. Writescarer is the resident manager, but the line will be operated by the West Virginia & Pittsburg.

FERNANDINA & WESTERN.—Surveys have been completed by J. M. Cook for the first 90 miles of this road and it is thought that the construction will soon be commenced. The line extends from Fernandina to Jasper, Fla., and Valdosta, Ga. Pres., S. A. Swann, Fernandina, Fla.

KENTUCKY SOUTHERN.—The incorporation of this company and the Southern Construction Co. to build the road was noted July 11. It is stated that the surveys have been completed, and that the construction will be commenced at once.

LOUISVILLE & NASHVILLE.—This company is reported to have just awarded a contract to John T. Grass, of Chattanooga, Tenn., for building a 3-mile extension from Sheffield, Ala., to Tuscumbia, and one to A. R. Wing, of Johnson City, Tenn., for a branch 30 miles in length to the Virginia Coal & Iron Co.'s mines, near Big Stone Gap, Va.

OHIO RIVER & CHARLESTON.—We are informed that this company has been completely reorganized, and that the road will probably be extended at an early date to points giving direct connections for Cincinnati and the Northwest, and that an early extension is also contemplated to the Tennessee coal fields. It is reported that a contract has already been awarded for grading 10 miles between Unaka Springs and Wilder's Forge, Tenn.

PENINSULA CONSTRUCTION CO.—This company has been formed at Baltimore to build a railway from Queenstown, Md., on the eastern shore of Chesapeake Bay southeastward to Lewes, Del., on the Atlantic Ocean, about 60 miles; also a branch from Queenstown to Centreville and Chestertown, a distance of 12 miles. With a steamboat connection across the bay this would make a direct route from Baltimore to the seacoast. Edward Stabler, Pres. Guardian Trust Co., and Geo. C. Baker, Vice-Pres. Third National Bank, both of Baltimore, are among those interested.

TUNNELTON, KINGWOOD & FAIRCHANCE.—This railway will probably be extended from Kingwood to Morgantown, W. Va., at an early date.

WEST VIRGINIA SOUTHERN.—Bids were asked until July 25 for building the first five miles of this railway noted in our issue of last week. Engrs., Venable & Vance, Charleston, W. Va.

Northwest.

CHICAGO, SIOUX CITY & BISMARCK.—An occasional correspondent writes us as follows: It looks now as if Northern Illinois and Iowa were to have another through railway line. The Chicago, Sioux City & Bismarck Ry. Co. is coming to the front again. This company has considerable property north of Evanston, Ill., on the lake shore, where the eastern terminal will be. From there it is proposed to run to Elgin, Rockford; thence a little north of west, coming down the North Menominee Creek and striking the Mississippi valley about three miles from East Dubuque. The company has made partial arrangements with the Illinois Central for running trains over the bridge at Dubuque. It has secured options on property in Dubuque, and when done will have a valuable right of way through Dubuque. The road will run north from Dubuque for about three miles, thence northwesterly on the north fork of the Little Maquoketa, striking the prairie about three miles north of Farley; from there it will strike New Vienna, and thence Greeley; from there it is proposed to follow a survey made some eight or ten years ago, keeping north of the Illinois Central and south of the C., M. & St. P. It is possible that instead of running to Sioux City, the road will go a little more northerly, taking in Sioux Falls.

BAYFIELD & WESTERN.—Incorporated in Wisconsin July 17 to construct a railway from some point on Lake Superior at or near Bayfield, northerly and westerly to the east fork of the Sand River in Bayfield county, thence southwest through Bayfield and Douglas counties to the Minnesota state line, a distance of about 100 miles; capital stock, $5,000,000, divided into 500,000 shares of $10 each; directors, R. D. Pike, Surrie G. Bell, I. H. Wing, William Knight, A. J. Pacard, O. Flanders, F. Bouton, H. Hannum, E. Leihy, Fred Fisher, Robert Inglis, and W. W. Downs.

DAKOTA, WYOMING & MISSOURI RIVER.—William T. Coad, Pres., Rapid City, S. Dak., is quoted as stating that it is expected that tracklaying will be commenced in a few weeks, and 26 miles be laid. The grading and bridging are three-quarters completed.

DULUTH & NORTH DAKOTA.—Mr. Hines, the projector of this railway, is quoted as stating that this road is being built by farmers who are at present without railway facilities, he himself raising 2,000 bu. of wheat a year and having to pay 10 cts. a bushel to get it to a railway station, and then 14 cts. a bushel to get it by a roundabout route to Duluth to market. The present plan is to build a road from the center of Cavalier county in a southeasterly direction through St. Thomas and Drayton, N. Dak., and Warren and Thief River Falls, Minn., and southeasterly to a junction with the Duluth & Winnipeg, if satisfactory arrangements can be made with that road. Forty miles of the grade have been completed, and the rest of that from Thief River Falls west has been contracted for. Warren has agreed to grade 10 miles of road, and Thief River Falls has held meetings to bond for 10 more miles. From Drayton west practically all the right of way has been secured. The company has been so successful that it proposes to begin a survey Oct. 1 of a line from Thief River Falls to Deer River, the terminus of the Duluth & Winnipeg. Next winter it will ask congress for permission to cross the Indian reservation, and next June there will be 1,000 farmers working on the line from Thief River Falls to Deer River. The line would be 118 miles long. The deepest cut on the survey west of Thief River Falls was 2 ft. 3 ins., while the highest grade was 4 ft. The company proposes to go on and build the road without selling stock or bonds to any one but farmers. Then it would issue the bonds for buying the rails. The whole line could be built for an average cost of $4,000 a mile. The only cash expenditure would be for boarding the graders, feeding the horses, and paying for the timber for ties. Duluth and Superior are asked to contribute $2,500 to pay accumulated indebtedness and defray the

cost of surveying the line from Thief River Falls to Deer River. As an instance of how little the work is costing, Mr. Hines states that Mr. Hill let the grade on the St. Thomas Line of the Great Northern at the rate of 15 cts. per yd., while they let theirs at 7 cts., the payment to be in stock of the company. Last winter they got out 28,000 ties, paying their labor in stock at the rate of $20 a month.

GULF & MANITOBA.—Incorporated in Iowa to build the Iowa portion of the projected North & South road, from Galveston, Tex., to Bismarck, N. Dak.; capital stock, $1,000,000; incorporators include J. J. Bell, of Des Moines, Ia.; B. H. Perkins, of Sheldon, Ia.; E. E. Carpenter, of Canton, S. Dak.; F. B. Johnson, of Topeka, Kan.; John K. Brown, of Jackson, Minn.; C. J. Rundell, of Wayne, Neb.; and H. M. Drake, of Brookfield, Mo.

SHEBOYGAN, ST. PAUL & CENTRAL.—It is reported that the contract for building the first section of this road southwest of Sheboygan, Wis., has been awarded to Bick & Bland, of Toledo, and the Crowley Construction Co., Portland Block, Chicago. The work now under contract will bring the road to Random Lake, a small station 22 miles south of Sheboygan. The road has been located all the way between the tracks of the Chicago & Northwestern and the Chicago, Milwaukee & St. Paul, finally connecting at Random Lake with the latter road.

Southwest.

EL DORADO SPRINGS & HARWOOD.—A press report from El Dorado Springs, Mo., states that the contracts have been signed by the railway committee of that place for the completion of a railway between El Dorado Springs and Harwood, a distance of 9½ miles, according to surveys made by Henry McPherson. The road is to be built by St. Louis parties, and will be completed within three months.

MARSHALL, NORTH & SOUTH.—Incorporated in Texas to build a railway from Marshall, Harrison county, to Center, Shelby county, 60 miles; capital stock, $1,000,000; incorporators: Wm. M. Johnson, H. B. Pitts, M. Scully, and others.

NEW ORLEANS & WESTERN.—This railway was noted quite fully last week. A. W. Swanitz, Cn. Engr., New Orleans, sends us the following additional information in regard to the award of contracts. The contract for about 20 miles of very heavy swamp work on our belt line road around the city has been awarded to J. A. Andrews, of New Orleans, bids ranging from 23 cts. to 34½ cts. per cu. yd. Contract for 500,000-bushel grain elevator for our terminals below the city was awarded to J. C. Stewart & Co., St. Louis, bids ranging from $70,000 to $87,000. Contract for rails was awarded to the Illinois Steel Co., of Chicago. H. K. Porter & Co., of Pittsburg, were awarded the contract for two compressed air locomotives of 12 tons each. Contract for engines is still in abeyance. Contract for two 4,000-ton cotton compresses was awarded to the De La Vergne Machine Co., New York. We are considering bids for warehouses covering 22 acres, also bids for electric light plant and general power station, and water plant. We shall also let contract for 100 or more laborers' cottages to be built upon our terminals. Contract for our wharves, covering 3,000 ft. river front, has not been let, but will be very shortly.

Rocky Mt. and Pacific.

GILA VALLEY GLOBE & NORTHERN.—It is reported that this railway has been extended this year from Pima, Ariz., north to Geronimo at the San Carlos Indian reservation line, 20 miles, and that surveys are completed for an extension from Geronimo to Globe City, about 60 miles. Secy., A. C. Laird, Tevaston, Ariz.

IRON MOUNTAIN.—Incorporated in California July 17 to build a railway from the Iron Mountain mines to Spring Creek crossing on the California & Oregon road, 17½ miles; capital stock, $100,000, all paid in; incorporators, Louis B. Parrott, Chas. P. Ells and M. M. O'Shaughnessy, of San Francisco; Alfred Fellows and Chas. W. Fielding, of England.

SACRAMENTO, FAIR OAKS & ORANGE VALE.—Incorporated in California July 12 to build a railway 20 miles in length for the Sacramento & Orange Vale Colonization Co.; capital stock, $500,000, with $20,000 paid in; incorporators, L. T. Hatfield, Thos. B. Hall, Frederick Cox, Wm. Schaw and Geo. M. Mott, all of Sacramento, Cal.

WEST SHORE.—Incorporated in California July 13 to build a railway through the city and county of San Francisco, and in San Mateo and Santa Cruz counties; capital stock, $2,000,000, with $80,000 paid in; incorporators, C. H. Sanger, Behrend Joost and J. W. Eisenhuth, of San Francisco; R. S. Thornton, of Colma, and Louis F. Dunand, of San Rafael.

STREET AND ELECTRIC RAILWAYS.

DERRY, N. H.—Charles Bartlett, of Derry, and A. H. Wilcomb, of Chester, have been appointed a committee to have a survey of the proposed Chester & Derry Electric Ry. made at once, as reports state that it is proposed soon to begin the construction of the road; estimated cost, $50,000.

READING, MASS.—The Lawrence & Reading St. Ry. Co. has been incorporated to build an electric railway from Reading to Andover, by way of North Reading, a distance of 10 miles; capital stock, $50,000; directors, Chas. F. Woodward and Chas. H. Spencer, of Wakefield; E. A. Carpenter and A. F. Upton, of North Reading; Newton Jacquith, of Andover, and Harley Prentiss, of Reading.

SOUTH FRAMINGHAM, MASS.—It is reported that the Pierce Construction Co. has been awarded the contract for building the electric road to Holliston and Milford, from this city, surveys for which are now being made.

HARTFORD, CONN.—It is reported that Henry S. Anderson, Gen. Man. United Electric Light Co., Springfield, Mass., is preparing plans for a new power house for the Hartford, Manchester & Rockville Tramway Co.; Pres., M. S. Chapman.

ROCKVILLE, CONN.—C. W. Clapp has about completed surveys for the proposed Rockville, Stafford & Southbridge Electric Ry.

BUFFALO, N. Y.—The state railroad commissioners have granted W. Caryl Ely permission to build an electric railway between this city and Niagara Falls.

COHOES, N. Y.—Geo. E. Fitts has been granted permission by the state railroad commissioners to equip the Cohoes City Ry. with electricity.

MOUNT VERNON, N. Y.—It is reported that the North Mount Vernon Surface R. R. Co. has voted to increase its capital stock from $20,000 to $250,000, for extending its road to Tuckahoe, Bronxville and White Plains. An application will soon be made for a franchise through those towns. The signatures of those representing over one-half of the assessed valuation of property along the route have been secured.

NYACK, N. Y.—The Nyack Traction Co. has applied for an extension of its franchise, as the original one has expired and the construction of its proposed electric road has not yet been commenced. If the extension is granted, permission will be asked for extending the road on the Piermont road and to West Nyack. Counsel, F. P. Demarest.

SYRACUSE, N. Y.—We are informed that the Syracuse St. R. R. Co. has awarded the contracts for the construction of the Madison St., the Grace St. and the Common Center Divisions to Belden & Seely, of Syracuse. The work will be commenced at once, and the different divisions are to be completed not later than Nov. 1, 1895. C. Loomis Allen, Engr., Syracuse St. R. R. Co.

WESTFIELD, N. Y.—It is reported that Wm. L. Minton has secured options on land between Chautauqua and Barcelona, on Lake Erie, for a projected electric railway.

ATLANTIC HIGHLANDS, N. J.—We are informed that the Atlantic Highlands, Red Bank & Long Branch R. R. is being built at the rate of about 600 ft. per day. The road will be operated for a few weeks by horse power. Gen. Man., A. G. Greenberg, 29 Broadway, New York.

ELIZABETH, N. J.—An effort is being made to have the Elizabeth St. Ry. Co. extend its road to Summit and have it equipped with electricity. Supt., J. C. Husbands.

LONG BRANCH, N. J.—The county commissioners have granted a franchise to the company which proposes to build an electric road to connect this city with Pleasure Bay and Asbury Park.

ORANGE, N. J.—The Freeman St. Improvement Co. has been organized to build an electric road from the Highland Ave. station of the D., L. & W. R. R. over the mountains to St. Cloud. Pres., John Davis; Vice-Pres., Franz Berg; Secy. and Treas., Robert Collins.

ALTOONA, PA.—Press reports state that the Cumberland Valley Traction Co., which for a long time past has been trying to connect by an electric road a number of the largest towns in Cumberland county, has sold its property to Benjamin F. Myers, Luther Georgas, George W. Crumbler, F. H. Alleman, W. K. Myers, all of Harrisburg, and John Skyles, of Blair county. S. Ritter Ickes and William Ickes, of Altoona, and Oliver H. Ormsby, of Pittsburg, have retired from the company. The road from Harrisburg to Carlisle will now be completed, taking in Mechanicsburg. After that it will be extended to Boiling Springs.

PHILADELPHIA, PA.—It is reported that surveys for the new branch in Chester of the Delaware County & Philadelphia Electric Ry. have been completed, and that specifications will be ready in a few days for contractors to bid on. The branch will start at Baltimore Ave. and Church Lane, west of Fernwood cemetery, run from Church Lane to Marshall road, and on Marshall road to the city line at Cobb's Creek, a distance of about 6,200 ft. Secy., M. W. O. Boyle, Philadelphia.——The Radnor Electric Passenger Ry. Co. has been incorporated to build a road from Radnor township, Delaware county, to Bryn Mawr and Rosemont, on the Lancaster and Philadelphia turnpike; capital stock, $30,000, with $3,000 paid in. It is reported that there is a big trolley scheme behind this road; in fact, it is only one of a number of lines which will ultimately be consolidated into a single chain, extending from Valley Forge to Paoli, thence to Wayne, Devon, Berwyn, Ardmore and other thriving towns along the Philadelphia division of the Pennsylvania R. R. The main stem of the system will be continued to this city, and its route will be such as to tap parts of the Philadelphia, Electric, People's and Hestonville roads, with one or more of which, or all of them, a traffic alliance will be negotiated. In addition, a number of branch lines are contemplated, one of which will reach Norristown, Bridgeport and Conshohocken. Pres., Henry D. Hughes, 21st and Ontario Sts., Philadelphia; Secy., and Treas., Andrew J. Reilly; directors, A. L. Register, David Pepper, Jr., F. E. Schemerhorn, F. H. Hawkins, H. A. Mullen and L. L. Eyre.

PITTSBURG, PA.—The Fort Pitt Traction Co. has been incorporated with a capital stock of $500,000 by Joshua Rhodes, Wm. B. Rhodes, of Allegheny; C. L. Magee, R. S. Frazer, of Pittsburg, and Wm. C. O'Reilly, of Crafton.

WASHINGTON, D. C.—Benj. F. Leighton, J. C. Dowell, W. R. Deeble, Frank T. Browning and other residents of Silver Spring, Woodside, Linden and Forest Glen, have been appointed a committee to investigate the feasibility of constructing an electric road from Washington to these suburbs, the proposed road to connect with the Brightwood Ry. at North Tacoma.

BRIDGEWATER, VA.—B. W. Whitmore and G. W. Berlin are interested in the construction of an electric line from Basic City to Bridgewater, to connect with the Chesapeake & Western R. R., now being built, according to reports.

OCALA, FLA.—It is reported that the Merchants' Union is considering the question of building an electric road to Silver Spring. Mayor T. G. Reardon is interested.

BIRMINGHAM, ALA.—Press reports state that the Birmingham Ry & Electric Co., which operates 25 miles of local steam dummy lines, has commenced the work of substituting electricity for steam. The East Lake road, six miles long, will be first adapted to the change, and it will be followed by the others. The estimated cost of changing this first section is about $50,000.

VICKSBURG, MISS.—C. R. McFarland is reported as interested in the building of an electric railway in Vicksburg.

SPRINGFIELD, O.—The county commissioners have granted the right of way for the Cedarville, Jamestown, Exemis & Springfield Ry. They have already granted the right of way for the Urbana, Bellefontaine, West Liberty & Springfield Electric Ry., which will be built by a syndicate headed by Gov. MacCorkle, of West Virginia.

TIFFIN, O.—Capital is being secured for the proposed electric railway between this city and Fostoria. Geo. E. Seney, of Tiffin, is interested.

ZANESVILLE, O.—Press reports state that ex-Auditor Patterson, A. W. Evans and L. W. Doane, of this city, have presented a petition to the county commissioners for right of way to construct an electric railway on the national pike west from this city to the county limits. They propose to build the road to Hebron, there to connect with a line projected by Columbus capitalists. The consent of the majority of the property holders along the proposed route has been secured.

SHELBYVILLE, ILL.—The Batesville & Oldenburg Electric Ry. Co. has been organized with a capital stock of $100,000. Pres., B. S. Sutton; Vice-Pres., A. A. Wackman; Secy., John A. Tindall; Treas., Jonas Joseph.

CHICAGO, ILL.—It is reported that the Calumet Electric St. Ry. Co. is considering the question of extending its road from South Park Ave. to connect with the Alley Elevated road at 63d St. Ch. Engr., R. H. Yeats; Electrician, H. McNulta.——The General Transportation Co. has been incorporated to build an electric conduit railway; capital stock, $200,000; incorporators, A. Boisen, Henry C. Millbrard and others; Attorney, M. D. Bradford, 480 Chamber of Commerce Bldg.

PITTSBURG, KAN.—The Kansas & Missouri Electric Ry. Co. has been incorporated to build a railway in Pittsburg and other places in Crawford county; capital stock, $25,000; incorporators, Samuel Barratt, Robert Robyn and A. L. Chaplin, of Pittsburg, Kan.; Robert Simons, of West Chester, Pa., and L. M. Bedel and Carl J. Simons, of Chestopa, Kan.

COLUMBIA, MO.—It is reported that Col. E. C. Moore has secured a franchise for an electric road.

KANSAS CITY, MO.—The North East St. Ry. Co. is about to petition for permission to extend its electric road to Budd's Park, a distance of one mile, work on which will begin at once. Electrician, A. O. Adney.

ST. LOUIS, MO.—Edgar Rapp, County Surv., is making surveys for the proposed electric railway, which is to be a branch of the Houseman Air Line, and will be built through Zeta, Fairview, Tuxedo, Old Orchard and Webster Park.

SACRAMENTO, CAL.—The Fair Oaks & Orange Vale Ry. Co. has been incorporated to build an electric road from this city to Orange Vale, by way of the Higgins grant, a distance of 20 miles; capital stock, $500,000, with full amount paid in; Pres., L. T. Hatfield; Secy., Geo. M. Mott; Treas., Thos. B. Hall.

ELECTRIC LIGHT AND POWER.

CHICOPEE, MASS.—Bids are asked until July 31 for erecting buildings for an electric light plant. Arch., F. R. Richmond, Springfield, Mass.; L. D. Sanborn, Chn.

PROVIDENCE, R. I.—It is reported a resolution has been introduced in the council appointing a committee of three to inquire into the feasibility of the city constructing its own electric light plant. Address, Wm. F. Shanaman, Mayor.

ROME, N. Y.—The city chamberlain has been directed to advertise for bids for lighting the city for one, three or six years.

SUMMIT, N. J.—The question of lighting this place by electricity is being considered by the town committee; estimated cost of plant, $30,000.

PHILADELPHIA, PA.—The Pennsylvania Heat, Light & Power Co. has been granted a franchise, and it is reported will at once begin the construction of its plant at an estimated cost of between $2,000,000 and $3,000,000. Carl W. McKinney and Robert Reeves, of Scranton; George Graham, Samuel Disston and others, of Philadelphia, are interested.

EASTON, MD.—Bids are asked by the Easton Gas & Electric Co., according to reports, for 75 arc and 1,250 to 1,500 incandescent lights and for a 30 or 40-HP. gas engine, etc.

ST. AUGUSTINE, FLA.—It is reported that E. M. Hammond, of Orlando; T. J. Appleyard, of Sanford, and Geo. F. Hapgood, of Maitland, are interested in a projected electric light plant at this place.

BROOKHAVEN, MISS.—The Brookhaven Mfg. & Improvement Co. has been granted a 25-year franchise for an electric light plant.

CANTON, MISS.—Bids are asked until Sept. 2 for erecting an electric light and water-works plant, as stated in our advertising columns. H. W. Latimer, Cy. Clk.; B. Maas, Chn. Com.

CHATTANOOGA, TENN.—The Chattanooga Light & Power Co. has been awarded the contract for lighting the city with electricity, and it is reported will build a new plant at an estimated cost of $50,000.

DAYTON, KY.—Bids are asked until Aug. 5 for lighting the city with 38 arc lights for five years from Oct. 29. C. H. Hayward, Cy. Clk.

MADISONVILLE, KY.—Bids are asked for 30 arc lights of 2,000 c. p. each. Address I. Bailey.

ELMWOOD PLACE, O.—An election was called for July 17 to vote on the question of lighting the town.

MOUNT STERLING, O.—It is reported that this place has voted to issue bonds for lighting the city and for water-works.

ANN ARBOR, MICH.—Bids are asked until Aug. 1 for lighting the streets for five years. G. V. Mills, Cy. Clk.

ST. IGNACE, MICH.—It is reported that this place will establish an incandescent light plant.

LA CROSSE, WIS.—It is stated that the La Crosse & Neillsville Electric Ry. Co. has secured a 30-day option on the Spaulding water power in Black River Falls, with a view of purchasing the same. The power is one of the finest in the state, and has been valued as high as $100,000. Surveys are being made and will be pushed as rapidly as possible.

LOGAN, IA.—The E. B. Hillman Co., of Peoria, Ill., has been granted an electric light franchise.

DALLAS, TEX.—Bids are asked by the commissioners' court until Aug. 12 for wiring the Dallas county court house. T. F. Nash, County Judge.

TRENTON, MO.—Bids are asked until Aug. 1 for lighting the streets with 25 arc lights of 1,600 c. p. each. J. B. Ward, Clk.

NEW COMPANIES.—Portland Light & Power Co., Portland, Conn.; E. F. Bigelow, A. H. Hale, E. I. Bell.

High Dam Power Co., Oswego, N. Y.; $100,000; Swits Conde, S. O. Conde, Geo. N. Burt.

Citizens' Electric Co., Michawka, Ind.; Pres., N. G. Niles; Vice-Pres., M. M. Fisher; Secy., D. O. Fonda.

Klamath Falls Light & Water Co., Klamath Falls, Ore.; $2,000; Chas. S. Moore, Geo. T. Baldwin, H. V. Gates.

Mendota Light & Heat Co., Mendota, Ill.; $2,500; John Goodiner, Anton Keulgen, G. H. Madden, Newton Imus.

Citizens' Electric Co., Plainfield, N. J.; $50,000, with $1,000 paid in; Henry G. Runkle, Elias R. Pope, J. C. Pope.

Citizens' Electric Co., Beaver Falls and New Castle, Pa.; R. S. Henderson, John C. Wallace, David H. Mathews, C. P. Wallace.

Arcade Mutual Electric Light Co., Columbus, O.; $50,000; Oliver E. Conner, Louis G. E. Hummel, F. Seibert, M. L. Robertson.

Amplified Electric System Co., St. Louis, Mo.; $1,000,000; Pres., J. L. Black; Secy., Hugh C. Gillick; Treas., George Van Rouzelen.

Pruyn Milling & Power Co., Oneonta, N. Y.; $75,000; to mill grain, to deal in power and to improve land; Irving L. Pruyn, Van B. Pruyn, Marquis L. Keyes, of Oneonta.

Cape May Court House Light, Heat & Power Co., Cape May, N. J.; $25,000, with $3,000 paid in; Alex. R. Springer, Cape May; Howard Bucknell, Walter W. Hartel, Philadelphia.

Solar Electric Co., New York, N. Y.; $100,000; to manufacture electrical appliances, etc.; Hewitt Boice, Jacob Rice, Kingston, N. Y.; Andrew D. Baird, Geo. A. Mullen, Brooklyn.

Dan River Power & Mfg. Co., Danville, Va.; $750,000; to utilize the water power of the Dan River at Long Shoals, four miles above Danville; Pres., T. B. Fitzgerald; Vice-Pres., Wm. P. Bethell; Secy. & Treas., R. A. Janes.

Ideal Electric Corporation, Philadelphia, Pa.; $100,000, with $1,000 paid in; to manufacture electrical apparatus, etc.; Geo. L. Colgate, Fanwood, N. J.; James D. McIntosh, Franklin, N. J.; Geo. S. Loutey, Wm. G. Toplis, James C. Jones, Philadelphia.

BRIDGES.

MONTAGUE, MASS.—At a town meeting July 20 it was voted to appropriate $5,000 for a new bridge over Saw Mill River.

HARTFORD, CONN.—The selectmen are considering the question of constructing a bridge near the property of Fred O. Olmstead.

AMSTERDAM, N. Y.—The mayor and the city engineer have approved the plans for the ironwork for the new bridge over the New York Central tracks at Bridge St.

BUFFALO, N. Y.—The board of park commissioners is considering plans for a bridge over the canal at Porter Ave.

BUFFALO, N. Y.—The contract for constructing a two-span bridge over the Buffalo Creek at the foot of Michigan St. has been awarded to the Wisconsin Bridge Co., of Milwaukee, Wis., at $38,700.

NIAGARA FALLS, N. Y.—It is stated that bids may soon be asked by the reservation commissioners for constructing the abutments for a proposed steel bridge, to be built next year. R. Porter, Supt. Comrs.

OYSTER BAY, N. Y.—The construction of a bridge over Mill Neck Creek to connect Bayville and Centre Island is being discussed by the residents of these places. The residents of Centre Island and the members of the Seawanhaka Yacht Club have offered to pay one-half the expense of constructing the bridge. Chas. H. Wetmore and Leroy Dresser, of Centre Island; W. L. Griffin, of Oyster Bay, and A. C. Underhill and Wilmot Cox are interested.

SYRACUSE, N. Y.—Bids are asked until July 30 for extending the stone arch culvert over Harbor Brook at West Genesee St. H. C. Allen, Cy. Engr.

SYRACUSE, N. Y.—W. H. H. Gere, Division Engr., is preparing plans for the substructure for a new canal bridge at Genesee St., and the plans for the superstructure are being prepared at Albany. The bridge will be 34 ft. in width.

BRIDGETON, N. J.—Plans have been prepared for a new bridge over the Cohansey River at Broad St. The bridge will be built jointly by the county and the South Jersey Traction Co.

HACKENSACK, N. J.—Bids are asked until July 27 for building two bridges, with stone abutments, steel beams and brick arches at Woodcliff. (Postponement from July 13.) I. D. Bogert, G. T. Haring, H. C. Dennett, Committee.——The committee of the freeholders has voted to erect a new bridge at Linwood Ave., Ridgewood, at an estimated cost of $2,250, and a bridge over the Saddle River at Dunkerhook, at an estimated cost of $2,500.

HAINESPORT, N. J.—Bids are asked until Aug. 3 for constructing the superstructure of a steel drawbridge, as stated in our advertising columns. E. A. Acott, Mount Holly, N. J., Engr. in Charge; W. P. Yonkers, Lumberton, N. J., Chn. Com.

JERSEY CITY, N. J.—Bids are asked until July 30 for constructing a bridge and building abutments on Montgomery St., over Cornelison Ave. J. C. Kaiser, Chn. St. Com.

PERTH AMBOY, N. J.—The committee of the board of freeholders has recommended the construction of a bridge over the Raritan River between this city and South Amboy, at an estimated cost of about $150,000.

LEECHBURG, PA.—The Leechburg Bridge Co. has been incorporated to build a bridge over the Kiskiminetas River from Gilpin township, Armstrong county, to Allegheny township, Westmoreland county; capital stock, $20,000; with $2,000 paid in. Treas., Frank J. Beale, of Leechburg.

LOCK HAVEN, PA.—Smith & Campion, of Mahanoy City, have been awarded the contract for building a bridge over the Susquehanna River from Allenwood to Dewart, at $36,500.

PHILADELPHIA, PA.—Local papers state that the survey chief has prepared plans for a double-deck steel bridge to take the place of the dilapidated structure known as Gray's Ferry bridge, and it is probable that the director of public works will urge the importance of the matter on the councils during the fall, so as to get an appropriation that will at least start the work. The present structure is owned by the Pennsylvania R. R. Co., with the officials of which the city authorities have had frequent conferences. The proposition has been urged that the railway pay one-third the cost; the Philadelphia Traction Co., which wants to use it, another third, and the city the balance. The estimated cost of the proposed double-deck steel bridge is $550,000.——It is reported that plans have been made and bids invited for a new stone bridge over Tacony Creek on the line of the Philadelphia, Newtown & New York R. R. to replace the present wooden structure. The new bridge will consist of two 25-ft. twin arches, and will be 130 ft. long. It will be constructed of substantial masonry, and is estimated to cost from $25,000 to $30,000.

SCRANTON, PA.—The west side board of trade has taken up the question of constructing a steel viaduct at the western end of the Linden St. bridge.

SEWICKLEY, PA.—The citizens are reported about to petition for the construction of a bridge over the Ohio River at this place. The board of viewers consists of H. S. A. Stewart, G. Y. McKee, and Charles Davis, County Engr.

WARREN, PA.—Bids are asked until Aug. 20 for constructing a steel highway bridge across the Allegheny River, separate bids for substructure and superstructure, as described in our advertising columns. L. T. Borchers, Chn. Com.

RALEIGH, N. C.—The city authorities are trying to effect an arrangement with the Seaboard Air Line, through John H. Winder, Gen. Man., for the construction of a bridge over the railway crossing on Morgan St. The structure, which is to be of iron and steel, will probably be a suspension bridge. Mayor Russ has notified the railway company that the aldermen have ordered the street to be extended across and on the other side of the railway cut, and has requested it to submit plans and specifications or the bridge, which must be built, according to a contract made between the city and the company in 1873. W. W. Gwathmey, Ch. Engr., Portsmouth, Va.

ATLANTA, GA.—The question of constructing a bridge at Alabama St. is again being considered.

ABBEVILLE, LA.—Plans are being prepared for a steel swing bridge, the draw span of which will be about 170 ft. in length, over the Vermilion River at this place. The contract will probably be awarded in August. W. W. Edwards, Chn. Com.

ASHTABULA, O.—The county auditor has received the specifications for the proposed high level bridge over the gulch at Ashtabula. The structure will be 920 ft. in length, 40 ft. wide, and about 114 ft. in height, and must be completed by March 1, 1896.

CINCINNATI, O.—Plans have been approved by the county commissioners for a bridge over Mill Creek at Spring Grove Ave., estimated to cost $47,617; this is $5,000 more than the estimate made last April. Frank S. Krug, County Engr.

COLUMBUS, O.—Bids are asked until Aug. 5 for building the east and west approaches to the Coe road bridge over Alum Creek; approximate quantities, 8,500 cu. yds. earth excavation, 3,000 cu. yds. hard pan excavation, 7,200 sq. yds. dress grading, etc. Wm. H. Halliday, County Audr.

EAST LIVERPOOL, O.—The East Liverpool Bridge Co. has been granted permission by the Secretary of War for constructing its proposed suspension bridge over the Ohio River. The structure will be a wire suspension bridge, with two towers erected on piers. It will be about 1,700 ft. long, counting approaches, and the channel span will be 700 ft. in length. The estimated cost of the structure is about $200,000. It is proposed to have it opened for traffic next February. It is reported that Wm. C. Jutte, of Pittsburg, Pa., has been awarded the contract for the masonry and the bridge approaches. Pres., J. E. McDonald, of East Liverpool.

LANSING, MICH.—The city clerk has been authorized to advertise for bids for the purchase of $25,000 of 4% bonds for a bridge over Grand River at Michigan Ave.

ASTORIA, ILL.—The board of supervisors has voted to pay half the cost of a new iron bridge across Sugar Creek on the Rushville and Astoria road, which it is proposed to have completed by the fall. Andrew Mummert is interested.

HENNEPIN, ILL.—The Illinois River Bridge Co. has been incorporated, to build a bridge over the Illinois River at this place; capital stock, $2,500; incorporators, W. F. Evans, M. B. Snyder, and S. A. Dunham.

PEORIA, ILL.—A. D. Thompson, Cy. Engr., has recommended the replacing of the old free lower bridge by the construction at once of a steel structure. The present bridge is a wooden one, 706 ft. in length, with a draw span of 286 ft. and three fixed spans.——The committee of the board of supervisors is reported as making arrangements to advertise in a few days for bids for constructing two bridges.

PARSONS, KAN.—Bids are asked until Aug. 5 for constructing a steel or iron 50-ft. span bridge, with 12 ft. roadway, over Negro Run, Fairview township. J. F. Thompson, County Clk.

DENVER, COLO.—Plans and specifications are asked until July 31 for a bridge across White River in Rio Blanco county, near Rangely, the bridge to cost not more than $3,500. H. A. Sumner, State Engr.

KANSAS CITY, MO.—The Kansas City Elevated Ry. Co. proposes to build an elevated viaduct 644 ft. long, for an electric and cable road, at an estimated cost of $40,000. Gen. Man., Robt. Gillham; Ch. Engr., R. J. McCarthy.

WARSAW, MO.—D. M. Eddy, of Stockton, Mo., has submitted a proposition to the citizens to construct a suspension bridge, 370 ft. in length, over the Osage River at this place, at an estimated cost of $8,000, if $1,000 bonus is raised.

WACO, TEX.—It is reported that at the next meeting of the county commissioners' court an election will be ordered to vote on the question of issuing bonds for constructing a new bridge in place of the present suspension bridge.

BUILDINGS.

BANGOR, ME.—Plans are asked until Aug. 26 for the Eastern Maine Insane Hospital buildings. Albion Little, Chn. Comrs., First National Bank, Portland.

EAST CAMBRIDGE, MASS.—Bids are asked by the county commissioners until Aug. 3 for the excavations and foundations for the new registry of deeds building. Archs., Wait & Cutter, 85 State St., Boston, Mass.; J. Henry Read, Comr.

PROVIDENCE, R. I.—Bids are asked until Aug. 5 for erecting a school house at Union Ave. and Althea St. Archs., Martin & Hall, 502 Industrial Trust Bldg. ——Plans are asked until Aug 12 for a high school building at Hope St. and Alumni Ave. David Burton, Chn. Com.

BROOKLYN, N. Y.—It is reported that the park commissioner will soon advertise for bids for constructing the western wing of the new Brooklyn Institute. The wing will have a frontage of 250 ft. and is estimated to cost about $300,000.

BROOKLYN, N. Y.—Bids are asked by the board of supervisors of Kings county until July 29 for improving the Hall of Records. Daniel Ryan, Supt. Construction; T. F. Farrell, Clk.——Bids are asked until July 31 for constructing a fire engine house on 86th St., near the Bay. F. W. Wurster, Com. Fire Dept.; Clarence A. Barrow, Ch. Clk.

NEW YORK, N. Y.—It is reported that H. Corn is about to erect a seven-story office building at 7 and 9 West 18th St., at an estimated cost of $200,000. Arch., Louis Korn, 621 Broadway.——James Libby & Son, 69 Liberty St., have leased from the Van Buren estate the property 5, 7, and 9 Union Square, and 20 East 15th St., about five and a half city lots, containing about 14,000 sq. ft. of ground. They will begin at once to erect an eight-story fireproof building. Limestone, buff brick, and terra cotta will be used in the front of the building, which will be ready for occupancy by May 1, 1896. It will be known as the Spencer building.

NIAGARA FALLS, N. Y.—Bids are asked until Aug. 1 for constructing a lower terminal station for the Inclined R. R. on the state reservation, and for a shelter house on Goat Island. Andrew H. Green, Pres. Comrs. State Reservation, 214 Broadway, New York.

CHESTER, PA.—Bids are asked until Aug. 13 for the superstructure of the U. S. public building to be built in this city, as stated in our advertising columns. Address Wm. Martin Aiken, Supervising Architect, Washington, D. C.

PHILADELPHIA, PA.—Bids are asked until July 30 for paving, painting, cementing floors and making other improvements to a number of school buildings. H. W. Halliwell, Secy. Bd. Education.

PITTSBURG, PA.—The Pittsburg Armory & Auditorium Association has applied for a charter to build a hall for large meetings, as stated in our issue of last week. Norman M. Smith, Albert J. Logan, W. H. Keech, Alfred E. Hunt, E. M. Bigelow, William Kennedy, James S. McKean, D. C. Ripley and others are interested.

BALTIMORE, MD.—Bids are asked until July 31 for erecting and for heating and ventilating a school building at Carey St. and Columbia Ave. J. T. Oster, Inspector of Bldgs.

BALTIMORE, MD.—The court house commission received the following bids July 8 for constructing the new court house, as advertised in Engineering News. The bids do not include heating, boilers, plumbing, gas piping, electric wiring and machinery, elevator cars, pumps, and machinery, decorating, gas and electric fixtures, sidewalks, or curbing:

William J. McClain, Columbus, O.	$1,765,692
E. L. Pennock, Philadelphia	1,787,000
John Gill & Sons, Cleveland, O.	1,849,000
Henry Smith, Baltimore	1,885,000
Willis & McClellan, Baltimore	1,894,000
Joseph J. Churchyard, Buffalo, N. Y.	1,984,000
Charles A. Moses, Chicago, Ill.	1,952,985
Probst Construction Co., Chicago, Ill.	1,971,000
P. J. Carlin, Brooklyn, N. Y.	1,979,900
John Waters, Baltimore	1,981,158
Murdoch, Campbell & Co., Chicago	1,988,664
George Mann, Baltimore	1,991,000
John N. Berger & Son, Lancaster, Pa.	2,142,727
James Baker Smith, New York	2,196,846
James A. McGonigle, Leavenworth, Kan.	2,198,000
McNeil Bros., Boston, Mass.	2,240,000
Norcross Bros., Boston, Mass.	2,280,000

RALEIGH, N. C.—The executive committee of the North Carolina Agricultural and Mechanical College has awarded the contract for building a brick dormitory to the North Carolina Car Co., Pres., W. E. Ashley, of Raleigh, at about $15,000. The contract calls for the completion of the building by Nov. 1.

COLUMBUS, O.—Bids are asked until Aug. 10 for constructing a four-story brick hospital building for the Protestant Hospital Association. Archs., Stribling & Fox; Secy., E. W. Leeds.

TOLEDO, O.—Plans are asked by the board of education until Aug. 12 for a high school building not to cost more than $125,000. To the competitor whose plans embrace more points for approval than any others, the awarding of a contract for preparing all of the required plans, specifications and details, and the general supervision of the work at a compensation equal to 5% upon the total cost of the work now to be completed. To the competitor whose plans shall stand second in the estimation of the board, a prize of $150 shall be awarded. To the third, a prize of $100. To the fourth, a prize of $50.

SOUTH BEND, IND.—Bids are asked until Sept. 6 for erecting a court house. Robert Myler, County Audr.

ROCK ISLAND, ILL.—Bids are asked until Aug. 1 for heating and ventilating the court house now being built. F. A. Johnson, Chn. Com.; S. J. Collins, Supt. Construction.

TOULON, ILL.—Bids are asked until Aug. 6 for constructing a jail for Stark county. W. W. Fuller, Clk. Bd. Supervisors.

PARIS, TEX.—Plans are asked until Aug. 2 for a new Lamar county court house, to cost not more than $90,000. J. C. Hunt, County Judge.

SALT LAKE CITY, UTAH—Bids are asked until July 30 for erecting a jail building. Arch., Fred A. Hale, Commercial Block; R. M. Baskin, Mayor.

MONTREAL, QUE.—It is reported that bids will soon be asked for the following improvements to the city hall: Drainage in basement, estimated to cost $1,263; plumbing fixtures, $3,214; tile and marble work, $3,655; new copper water pipe, $1,912; ventilating fan, $500; labor for plumbing, $4,500; concrete in basement, $2,000; excavation and new hard wood floors, $3,646; tiled floors in corridors, $12,514; ventilation, $20,000. Engr., J. E. Dore, City Hall.

PETERBORO, ONT.—Bids are asked until Aug. 3 for erecting a car shop 330×60 ft., for the Canadian General Electric Co. Archs., Strickland & Symons, 85 Adelaide St., Toronto.

TORONTO, ONT.—Bids are asked until July 31 for erecting a store building, including iron work, at Yonge and Queen Sts., for P. Jamieson. Archs., Curry, Baker & Co.

WATER-WORKS.

CONTOOCOOK, N. H.—The appointing of a committee to investigate the question of works was noted in our issue of July 11. A meeting has been called for July 27, to consider the report of the committee. G. A. Curtice, Chn.

SOMERSWORTH, N. H.—A favorable analysis has been made of a supply from driven wells, and it is stated that the city will now proceed to put in new works.

ROCHESTER, VT.—Press reports state that specifications have been completed for works, and that the fire district will receive bids for the construction.

WHITMAN, MASS.—The town has voted to issue $5,000 in bonds for extending the mains.

NORWICH, CONN.—Press reports state that the Meadow Brook reservoir, containing 50,000,000 gallons of water, was emptied July 17 by the breaking of the bulkheads.

BROOKLYN, N. Y.—Bids are asked until Aug. 3 for a supply of 20 to 8-in. cast iron pipe and 228,480 lbs. of special castings, as stated in our advertising columns. Alfred T. White, Comr. Cy. Wks.

BUFFALO, N. Y.—The council has published a notice of intention preliminary to advertising for bids for two new 30,000,000-gallon pumping engines for the lower pumping stations.——The following bids were received July 20 for constructing the new intake: A. C. Douglas, Niagara Falls, $64,890; Dwyer & McNaughton, Buffalo, $72,944; Clement & Co., Buffalo, $66,900; Anderson, Barr & Usher, Niagara Falls, $68,975.

CARTHAGE, N. Y.—The citizens of West Carthage have elected a board of water commissioners, and will take steps at once to secure works. Chn., Dr. G. D. Hewitt; Secy., S. M. Gibbs; Treas., M. P. Mason.

DANSVILLE, N. Y.—At a public meeting last week John Young, of Geneseo, reported that a complete system of water-works could be constructed for about $60,000, and a system of sewers for about $44,000. The trustees were instructed to secure estimates of the probable cost of water rights, etc. Dr. J. H. Jackson and A. O. Bunnell are interested.

DELHI, N. Y.—At a special village meeting the trustees were instructed to negotiate for the purchase of the works. The plant was constructed in 1872, and it is stated that a new reservoir and larger mains are needed.

FORESTVILLE, N. Y.—The contract for works is reported to have just been awarded to W. B. Wilson, of Buffalo.

LE ROY, N. Y.—A press report states that the trustees have voted to give C. F. Prentice $1,000 for water and power for fire purposes for one year, rather than grant him a franchise such as he desires.

NYACK, N. Y.—Dr. E. H. Maynard, George Dickey and A. E. Christie have been appointed a board of water commissioners.

ONEIDA, N. Y.—The village trustees have agreed to purchase the plant of the Warner Water Co. for $148,000. The company at first asked $161,000.

PERRY, N. Y.—The election at which the citizens voted to issue $40,000 in bonds for water works has been decided illegal, and another election will be held Aug. 2. C. M. Smith, Cy. Clk.; T. Harry Bussey, Pres. Bd.

STAPLETON, N. Y.—Maj. C. T. Barrett, Engr., has presented plans for a new water supply for the county almshouse, estimated to cost $3,000, and it is stated that bids will be asked at once for the construction.

TARRYTOWN, N. Y.—The bids recently received by the Tarrytown improvement association for the extension of the water mains are reported to have been rejected.

WEST TROY, N. Y.—Alexander Potter, of New York, has been retained by the West Troy Water Works Co. to prepare plans for the complete rehabilitation of its plant. The work includes the completion of a new dam across the Mohawk River.

BORDENTOWN, N. J.—The Citizens' Pure Water Co. was incorporated July 19 to construct works at this place; capital stock, $50,000; with $1,000 paid in; incorporators, Henry M. Sipie, C. Taylor Leland, Isaac Gabel and Robert I. Tantum, of Bordentown, and others.

JERSEY CITY, N. J.—Bids are asked under July 30 for a quantity of cement, brick, steam and water fittings and miscellaneous supplies. I. W. Startup, Clk. Bd.

CAPE MAY C. H., N. J.—The Cape May Court House Water Co. was incorporated July 20 with a capital stock of $25,000, commencing with $6,000; incorporators, A. R. Springer, J. L. Springer and Caroline M. Springer, of Cape May C. H., and others.

ALLEGHENY, PA.—Robert Swan, Superv. Engr., has submitted plans for purifying the new water supply. Local papers state that the work will consist of a crib 32 ft. wide and 2,500 to 3,000 ft. long sunk 4 or 5 ft. beneath the river bed some 200 ft. from the shore. The construction of this infiltration system is estimated to cost about $25,000.

HOMESTEAD, PA.—A special election was held July 23 to vote on a bond issue of $40,000, including $15,000 of water bonds.

MESHOPPEN, PA.—It is reported that this borough has voted to construct water works.

MIDDLETOWN, PA.—It is reported that Harrisburg capitalists wish to construct works at this place.

PITTSBURG, PA.—Bids are asked until July 27 for building additions to boiler houses, erecting two steel smokestacks, putting in two additional intake cribs and two 48-in. cast iron intake pipes from same, etc. E. M. Bigelow, Dir. Pub. Wks.

SELLERSVILLE, PA.—Bids are asked until Aug. 5 for constructing a system of water works at this place, as stated in our advertising columns. Warren Cressman, Engr.; Potter & Folwell, Consult. Engrs.; H. J. Zane, Clk.

WASHINGTON, D. C.—Bids are asked until Aug. 6 for furnishing 7,008 ft. of 4-in. pipe, 3,000 lbs. castings, pig lead, etc. Col. John M. Wilson, Engr. Pub. Bldgs. and Grounds.

NORFOLK, VA.—The city received seven bids July 16 for constructing a gang well system for a supply of 2,000,000 gallons a day. Local papers state that the bids were as follows: Leach Bros., Glassboro, N. J., to furnish labor, tools, etc., and do work for $10 a day; W. H. Gray & Bro., Chicago, Ill., system complete, except main to the pumping station, $13,500; William D. Andrews & Bro., New York, do the work at certain rates per day for labor and machinery, on the percentage plan; National Artesian Well Co., Providence, R. I., furnish land and complete system for $18,000; or the city to furnish land and pay 3¾ cts. per gallon for 2,000,000 gallons and 3 cts. per gallon for all over that amount; C. A. Ray, East Providence, R. I., furnish wells and water at the rate of $500 for each 100,000 gallons; J. P. Miller & Co., Chicago, Ill., $15,000, the city to make the connections; A. L. Spandour, Norfolk, furnish the system, without guarantee as to continuing supply, for $12,500.

GRAFTON, W. VA.—The council is considering a proposition for extending the service to West Grafton.

CHARLOTTE, N. C.—It is reported that the Charlotte Water Co. will put in a filter plant.

COLUMBUS, GA.—Steps are being taken to vote agal upon an issue of water-works bonds.

ROME, GA.—The commissioners are reported as considering the question of a filter plant.

CANTON, MISS.—Bids are asked until Sept. 2 for the construction of works; also for a franchise for works, as stated in our advertising columns. B. Mass, Chn. Com.; H. W. Latimer, Cy. Clk.

HUMBOLDT, TENN.—The city has sold $15,000 in bonds for works and electric lights, and a plant will be constructed at once. John T. Crews, Mayor.

ELIZABETHTOWN, KY.—S. K. Felton, of Cuthbert, Ga., has been engaged to make plans and specifications and superintend the construction of works, for which the city has voted to spend $18,000. Bids will be asked within a few days for the construction. R. L. Wintersmith, Mayor; C. T. Warren, Cy. Clk.

CARROLLTON, O.—At an election July 16 the citizens voted 218 to 40 to issue $35,000 in bonds for water-works.

CHAGRIN FALLS, O.—Efforts are being made to secure works at this place.

CLEVELAND, O.—Bids are asked until Aug. 15 for repairing or rebuilding pumping machinery now at the Division St. pumping station. D. E. Wright, Dir. Pub. Wks.

NORWALK, O.—An election will be held Aug. 13 to vote on an issue of $100,000 in bonds for new works. At an election Aug. 1, 1893, a similar proposition lacked but 6 votes of having the necessary two-thirds.

VERMILLION, O.—The water-works question is again being agitated, according to reports.

ANDREWS, IND.—The question of constructing works is being considered. There is talk of leasing the present well and granting a franchise. D. E. Purviance, Town Clk.

COLUMBUS, IND.—The contract for laying 20 to 8-in. mains has been awarded to Snyder & Williams, of Dayton, O., at $13,900. Levi Hege, Cy. Engr.

GOSHEN, IND.—Bids were received July 23 for laying about 8,000 ft. of 6-in. water pipe, with 22 hydrants. E. B. Leaming, Cy. Clk.

ALLEGAN, MICH.—A special election was held July 24 to vote on an issue of $8,000 in bonds for a pumping engine, accordnig to reports.

MILFORD, MICH.—Bids are asked until July 29 for the purchase of $18,000 of 5% water bonds. Geo. P. McCoy, Clk.

SOUTH HAVEN, MICH.—It is stated that the water supply will be more than doubled at this place.

CHICAGO, ILL.—Bids are asked until July 29 for laying water mains in seven streets. W. D. Kent, Comr. Pub. Wks.

EARLVILLE, ILL.—The contract for works is reported to have been awarded to Campbell, Dennis & Co., of Joliet, at $9,439.

GENOA, ILL.—An election will be held Aug. 6 to vote on the construction of works, for which Hill & Enricht, of Chicago, have prepared plans, as noted in our issue of July 11. H. A. Perkins, Clk.

STREATOR, ILL.—Press reports state that a 1,500,000-gallon filter plant has been purchased.

DEPERE, WIS.—S. J. Whitemore, of West Superior, who recently secured an option on the West Side Co.'s plant at $15,000, has been granted an option on the East Side plant at $24,000, and it is stated that if a favorable franchise can be secured from the city a new pumping system will be put in, instead of the present supply from artesian wells.

LANCASTER, WIS.—At an election July 16 the citizens voted 353 to 134 to issue $24,000 in bonds for water-works.

KNOXVILLE, ILL.—Bids are asked until Aug. 12 for laying about four miles of cast iron water pipe, etc., as stated in our advertising columns. L. M. Smith, Cy. Clk.

LOGAN, IA.—It is stated that work on extension of the water-works will be commenced at once.

OXFORD JUNCTION, IA.—The question of works is again being agitated.

RUTHVEN, IA.—The "Press" of this city is agitating the construction of works.

ALDEN, MINN.—Bids are asked until July 30 for constructing works, according to reports. Peter Hansen, Recdr.

DULUTH, MINN.—A press report of July 19 states as follows: It is now settled that work will be begun in a short time on the $12,000,000 Minnesota canal, which is to furnish pure water for Duluth and the entire northern portion of the state. George Braumling, of Chicago, a director of the company, and a party of Chicago and Minnesota capitalists have started on a trip over the proposed route of the canal. The canal, in addition to furnishing pure water, will provide a great water power.

KASSON, MINN.—The contract for works is reported to have been awarded to E. E. Huelster & Co., of Kasson, at $6,190.

MOUNTAIN IRON, MINN.—The proposition to purchase the works for $8,700 was defeated at the election last week.

HELENA, MONT.—A special election will be held July 29 to vote on the question of municipal ownership of the works.

OZARK, MO.—John C. Rogers is reported as interested in projected works at this place.

ST. LOUIS, MO.—The bids received July 9 for building engine house complete for pumping station No. 3 were as follows:

R. S. Colnon, St. Louis	$63,550
Anderson Bros., St. Louis	53,373
M. J. Brennan, St. Louis	68,307
F. McCabe, St. Louis	64,457
Kerr & Allen, St. Louis	61,238
Hill-O'Meara Construction Co., St. Louis	60,423
Thompson Gray, St. Louis	63,279
Allen & Weths, St. Louis	69,788
Gillick Bros, St. Louis	69,990
Thomas Mockler, St. Louis	59,300
McCully Stonemason Co., St. Louis	57,260
John Low, St. Louis	63,868

UNION, MO.—Bids for the construction of works were opened July 20, but it was decided to make certain improvements, which will necessitate further action in the matter, until additional funds are available. It is expected that the matter will be taken up again and contracts let in January next. William H. Bryan, Consult. Engr., Turner Bldg., St. Louis.

CAMDEN, ARK.—The Camden Water-Works Co.'s plant and franchise were sold July 15 to E. E. Paramore, of Manchester, Mass., for $28,000.

NORFOLK, CAL.—It is reported that works will be constructed at this place.

SAN JOSE, CAL.—The San Luis Obispo Water Co. was incorporated July 12 with a capital stock of $800,000, commencing with $50,000; incorporators, E. McLaughlin, B. D. Murphy, C. T. Ryland, Edward Williams, of San Jose, and others.

VENTURA, CAL.—At an election July 9 the citizens voted to issue $130,000 in bonds to purchase the water-works and electric light plant.

FLAGSTAFF, ARIZ.—The Flagstaff Water-Works Co. was recently incorporated with a capital stock of $200,000, and we are informed by E. S. Clark that the supply will be from mountain springs. The work will include about 14 miles of 6-in. and 5 miles of 4-in. iron pipe, 40 hydrants, etc., and will cost about $80,000.

MIDWAY, UTAH.—It is stated that a company has been incorporated, with a capital stock of $7,000, to construct works at this place.

ORANGEVILLE, ONT.—Bids are asked until July 31 for the construction of works, as stated in our adverman, Toronto; W. T. Bailey, Mayor.

ALEXANDRIA, ONT.—Bids are asked until Aug. 6 for the construction o fworks, as stated in our advertising columns. Ch. Engr., Alexander Potter, New York.

IRRIGATION.

SALT LAKE CITY, UTAH.—The Salt Lake Irrigation & Power Co., recently incorporated with a capital stock of $10,000,000, is reported about to issue $5,000,000 of 5% bonds. The company owns a chain of lakes in Uintah county, at the head of the Provo River, which are being converted into natural reservoirs for irrigation purposes.

EL PASO, TEX.—Press reports state as follows: The Mexican government is preparing to turn its attention actively to the assistance of the project to build a storage reservoir in order that the waters of the Rio Grande River may be utilized for irrigating the El Paso valley. Ygnacio Garfias, an engineer, has been appointed by the Mexican goverment to look into the matter. He has urged the necessity for action, and says the minister of public works is interested, especially since learning of recent schemes to dam the river far above El Paso in New Mexico.

NEW COMPANIES.—Puente Land & Water Co., Los Angeles, Cal.; $100,000; J. W. Hudson, Wm. R. Rowland, B. F. Rowland, of Puente.

American Irrigating Machine& Land Co., St. Louis, M.; $100,000, with full amount paid in; to build water elevators, pumps, irrigating lands, etc.; Alexander Hogeland, Lincoln, Neb.; Edgar P. Davis, Omaha, Neb.; Wm. H. Moore, St. Louis.

Hamilton Irrigation Co., San Diego, Cal.; $1,000,000, with $500,400 paid in; to construct dams, flumes, tunnels, etc., for irrigating purposes; W. D. Hamilton, Geo. N Barrett, J. H. Grovesteen, Joseph Billis, W. J. Montgomery, of San Diego.

SEWERAGE.

WATERVILLE, ME.—The council has instructed the committee to employ an engineer to ascertain the best method of disposing of the sewage of the Hayden Brook Valley. I. E. Getchell, Cy. Engr.

ROCHESTER, N. H.—The council received the following bids July 15 for constructing the East Rochester sewers, as advertised in Engineering News: Engr., Ernest W. Bowditch, Boston: Allen & French, $10,986; W. S. Marsh, $12,128; H. W. Warren, $10,366; F. E. Hall, $12,775; McCusker Bros., $11,350; J. Walker (awarded contract), $10,511.

PITTSFORD, VT.—Flood & Sherrill, of Sandy Hill, N. Y., have been awarded the contract for a sewerage system at this place. The principal promoter is Dr. H. F. Walker, of New York. Engr., John W. Burk, 45 Broadway, New York.

BOSTON, MASS.—Bids are asked until July 29 for constructing about 2,900 ft. of 15 to 10-in. pipe sewers, 80 cu. yds. rock excavation, 118 cu. yds. rubble masonry. B. T. Wheeler, Supt. Sts.

MARLBORO, MASS.—The aldermen have voted to appropriate $9,884 for sewers. B. R. Felton, Cy. Engr.

NATICK, MASS.—Bids are asked by the committee until Aug. 1 for constructing the engine house, boiler house and chimney for the sewerage system.

STONEHAM, MASS.—It is reported that a committee has been appointed to secure surveys and plans for a system.

HARTFORD, CONN.—The street commissioners are making arrangements preparatory to advertising for bids for constructing the intercepting sewer.

ROCKVILLE, CONN.—Plans for a system have been prepared by S. M. Gray, of Providence, R. I.

BINGHAMTON, N. Y.—The city engineer has made estimates for extending the Front St. sewer by constructing a 20-in. iron pipe sewer, at an estimated cost of about $10,000, or by constructing a 6 × 4-ft. trunk sewer along the bank of the Susquehanna River at $50,000.——An election will be held Aug. 1 to vote on the question of issuing bonds for sewers and paving.

BROOKLYN, N. Y.—Bids are asked until Aug. 6 for constructing sewers in five streets. A. T. White, Comr. Cy. Wks.

BROOKLYN, N. Y.—The following bids were received July 29 for constructing sewers: District No. 1, sub-division No. 6—Marris & McGuire, $23,474; Stratford & Hawkes, $20,372; McKeever & Brother, $18,038; Clapp & Shipman, $18,001; Zibber & Co.,$17,772; Bogart and Farrell, $17,156; Richard O'Grady, $16,780. Subdivision No. 5—James F. Gillen, $23,105; Stratford & Hawkes, $21,952; Bogart & Farrell, $20,127; Clapp & Shipman, $18,978.

COXSACKIE, N. Y.—The commission will soon make surveys for a system. A. J. Collier, Village Clk.

ITHACA, N. Y.—Bids are asked until Aug. 3 for constructing section 5 of the sewerage system, as stated in our advertising columns; approximate quantities: 11,530 ft. of 8-in. and 10,770 ft. of 6-in. vitrified pipe, 13,163 cu. yds. of earth excavation and 2,015 cu. yds. of rock excavation, 88 manholes. Henry N. Ogden, Ch. Engr.; Roger B. Williams, Chn. Comrs.

JAMAICA, N. Y.—The commissioners have voted to purchase land for sewage disposal purposes, surveys for which will be made at once by J. J. McLaughlin, Cy. Engr.

MOUNT VERNON, N. Y.—Bids are asked until Aug. 6 for constructing a sewer in Elm St. E. G. Pease, Cy. Engr.

NEW YORK, N. Y.—Bids are asked until Aug. 1 for constructing sewers in two streets and a trunk sewer in four streets. Louis F. Haffen, Comr. St. Improvements, 2622 Third Ave.

PORT RICHMOND, N. Y.—The trustees of New Brighton and the commissioners of Port Richmond are to meet July 29 to make arrangements for constructing a joint outlet sewer to empty into the Kill von Kull. G. S. Brantingham, Chn. Joint Bd.; C. H. Ingalls, Secy.

ROME, N. Y.—Wm. B. Landreth, of Schenectady, has been engaged to report on the plans for a system prepared by the Stanwix Engineering Co., of Rome.

SOLVAY, N. Y.—It is reported that this town will have a system of sewerage as soon as the water-works are completed.

SYRACUSE, N. Y.—Bids are asked until July 30 for constructing a 32 and 30-in. brick sewer in three streets. Henry C. Allen, Cy. Engr.

TROY, N. Y.—Bids are asked until July 30 for constructing a 12-in. pipe sewer in Liberty St. E. O. Ross, Secy. Contract Bd.

MADISON, N. J.—It is reported that the construction of a system is being considered.

RUTHERFORD, N. J.—The board of health has engaged an engineer to prepare plans for a system, according to reports.

ROSELLE, N. J.—The following bids were received July 15 for constructing 18,000 ft. of lateral sewers, as advertised in Engineering News. Engr., Carrol Ph. Bassett, Summit, N. J.; Neff & Mitchell, Newark, N. J., $11,021; A. Costa, Orange, N. J., $8,508; John Marsden, Utica, N. Y., $11,113; W. H. Waters, Bayonne, N. J., $15,890; James J. Coogan, Bayonne, $11,865. The itemized bids will probably be published next week.

TRENTON, N. J.—Bids are asked until July 30 for constructing a sewer in Warren St. C. E. Murray, Cy. Clk.

CRAFTON, PA.—Bids are asked until Aug. 5 for constructing sewers in six streets and for paving portions of the same streets. F. R. C. Perrin, Borough Clk.

NEW KENSINGTON, PA.—Bids are asked until Aug. 1 for constructing a pipe sewer in 11th St. Engrs., Trimble & Miller, 150 Fourth Ave., Pittsburg; L. S. Strasser, Secy.

PITTSBURG, PA.—Bids are asked until July 27 for constructing the Four Mile Run sewer system, which will include about 16,000 ft. of brick sewer, 12 ft. in diameter at the outlet, and 14,000 ft. of 20 to 15-in. pipe sewer. The system will drain 2,315 acres in Homewood, Brushton, Wilkinsburg and part of Hazelwood, and is estimated to cost from $250,000 to $300,000. E. M. Bigelow, Dir. Pub. Wks.

RANKIN, PA.—An election has been called by the council for Aug. 13 to vote on the question of issuing $50,000 in bonds for a system.

RALEIGH, N. C.—J. M. Manning, of the board of health, is reported as urging the construction of a system.

ATHENS, GA.—The committee is considering the question of beginning the construction at once of a brick sewer in Broad St. and pipe sewers in other streets in the business portion of the city.

DAYTON, O.—The council is considering an ordinance for constructing sewers in the west side at an estimated cost of $125,000. Frank Turner, Cy. Engr.

FOSTORIA, O.—John P. Force, Cy. Engr., has recommended the adoption of the intermittent downward filtration method of sewage disposal, with a furnace somewhat similar to a garbage crematory in which to burn the sludge. It is proposed to buy 24½ acres of land and to locate 19 filter beds on 18 acres and leave the remaining 6½ acres to be treated by broad irrigation occasionally. The estimated cost of preparing the beds and constructing reservoir, sludge and pump well, buildings, etc., is estimated at $25,020.

LOGAN, O.—Bids are asked until Aug. 20 for constructing a system of sewers, as stated in our advertising columns. Frank Snyder, Columbus, Engr.; Peter Kleinschmidt, Chn. Com.

INDIANAPOLIS, IND.—Bids are asked until July 27 for constructing 330 ft. of 10 and 6-in. pipe sewers, and until August 3 for constructing about 10,000 ft. of 18 to 6-in. pipe sewers, and about 2,500 ft. of 36 to 20-in. brick sewers. C. C. Brown, Cy. Engr.

ANN ARBOR, MICH.—The city treasurer has been authorized to issue $30,000 in bonds for the Hill and Huron St. sewers.

BLOOMINGTON, ILL.—The question of improving the system in that portion of the city around Sugar Creek is being agitated.

MARSHFIELD, WIS.—The Iowa Engineering & Construction Co., of Clinton, Ia., is preparing plans for a sewer system of Marshfield, which will comprise about 12 miles of pipe sewers, and will also provide for a disposal plant.

INDEPENDENCE, MO.—Wynkoop Kiersted has been engaged to prepare specifications for a system.

OAKLAND, CAL.—The council is considering an ordinance appropriating $40,000 for a storm sewer in 34th St.

DENVER, COLO.—Bids are asked until July 30 for constructing and repairing a section of the Capitol Hill sewer. E. Monash, Pres. Bd. Pub. Wks.

OTTAWA, ONT.—Local papers state that the plans and estimates for the main drainage scheme as recently proposed by the main drainage committee, have been prepared by the engineer. The new scheme provides for the enlargement of the western sewer from the outlet at the gully to Preston St., so that the former proposal for two separate sewers, one for storm water with a separate outlet, and the other for sanitary purposes, will be dispensed with. The additional cost will be about $150,000, making the total cost of the proposed system about $500,000.

GARBAGE DISPOSAL.

NEW YORK, N. Y.—The American Reduction Co., the International Reduction Co., and the United States Alumina Phosphate Co. have filed articles of consolidation, forming the Consolidated American Reduction Co., of New York city. The company is to gather garbage and refuse and manufacture fertilizer, has a capital of $400,000, and will operate in the cities of New York, Syracuse and Utica. The directors are Samuel M. Roosevelt and N. B. Powter, R. G. Walling, of New York city; D. R. Case, of Bristol, R. I., and John B. Campbell, of Brooklyn.

SYRACUSE, N. Y.—The board of health has directed the clerk to notify the American Reduction Co. that unless the construction of its plant is commenced within 10 days the contract will be declared void and its $3,000 bond forfeited.

SAN FRANCISCO, CAL.—The supervisors continue to discuss the question of garbage disposal. There is talk of the city constructing a plant instead of granting a franchise.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked until July 30 for grading sections 2 and 3 of Commonwealth Ave., the work to include 5,000 cu. yds. of excavation, etc. B. T. Wheeler, Supt. Sts.

BRIDGEPORT, CONN.—The committee has recommended the paving of Fairfield Ave. with asphalt.

BROOKLYN, N. Y.—Bids are asked until Aug. 2 for repaving four streets with asphalt. A. T. White, Comr. Cy. Wks.

JAMAICA, N. Y.—Bids are asked until July 30 for improving two streets and the North Hempstead Turnpike. John J. McLaughlin, County Engr.

JAMESTOWN, N. Y.—The following bids were received July 15 for paving two streets and one alley; John Conway, Pres. Bd. Pub. Wks.: Thomas Mahoney (awarded contract), $21,476; E. M. Ayres, $22,138; L. H. Gipp, $26,147.

NEW YORK, N. Y.—Bids are asked by the department of street improvements, 2,622 Third Ave., until Aug. 1 for grading and flagging two streets and paving one with granite blocks.

SYRACUSE, N. Y.—Bids are asked until July 29 for the purchase of $120,000 of 4% local improvement bonds. E. F. Allen, Treas.—Bids are asked until Aug. 5 for paving West Fayette St. with asphalt or brick H. C. Allen, Cy. Engr.; H. F. Stephens, Cy. Clk.

BEVERLY, N. J.—Bids are asked until Aug. 1 for resurfacing one-half mile of Warren St. Charles Stokes, Cy. Surv.

HOBOKEN, N. J.—Bids are asked until Aug. 14 for paving portions of six streets with asphalt. Tivy & Smith, Cy. Survs.; M. V. McDermott, Cy. Clk.

HOMESTEAD, PA.—An election has been called for July 23 to vote on the question of issuing $20,000 in bonds for grading and paving, and $5,000 for improving the sewer system.

CRAFTON, PA.—Bids are asked until Aug. 5 for grading and paving portions of six streets. F. P. C. Perrin, Borough Clk.

MOUNT CARMEL, PA.—Bids are asked until Aug. 1 for excavating and filling portions of Vine St. Geo. A. Stecker, Chn. Com.

MONTGOMERY, ALA.—J. W. Persons, Cy. Engr., writes us that the bids received July 15 for paving South Court St. with brick have been rejected, and that the city will probably do the work.

CINCINNATI, O.—Bids are asked by the board of administration until Aug. 16 for paving Roll Ave. with brick.

COLUMBUS, O.—Bids are asked until Aug. 6 for grading and paving Jaeger St. J. A. Fanning, Clk. Bd. Pub. Wks.

INDIANAPOLIS, IND.—Bids are asked until July 30 for 7,620 sq. yds. of cement sidewalks and 1,650 lin. ft. of resurfacing, etc., and until Aug. 13 for 3,912 sq. yds. of asphalt paving. C. C. Brown, Cy. Engr.

MARION, IND.—Bids are asked until Aug. 8 for 18,341 sq. yds. of brick paving. (Postponement from July 16.) L. M. Overman, Cy. Engr.; John Watts, Cy. Clk.

STREATOR, ILL.—Bids are asked until Aug. 5 for improving about 3,500 lin. ft. of four streets. W. J. Zilm, Cy. Clk.

MILWAUKEE, WIS.—Bids are asked until Aug. 1 for paving Mason St. with brick on concrete foundation. G. H. Benzenberg, Cy. Engr.

MISSOULA, MONT.—We are informed that the following bids were received July 15 for constructing a wagon road; D. J. Bailey, County Clk. and Recdr.:

F. Dierman, Missoula, Mont.	$3,375
R. Coombs, Bonner, Mont.	2,995
J. W. Keith, Missoula, Mont.	2,850
Mathers & Florin, Thompson, Mont.	2,735
John Britt, Missoula (awarded contract).	2,650

The road is about 2.8 miles long, following the course of the Blackfoot River, not less than 8 ft. wide, retaining walls to be built wherever necessary to prevent material from sliding into the road, cribbing to be used to prevent material from sliding into the road and culverts to be built wherever necessary; grade not to exceed 1 ft. to the rod, and necessary turnouts to be made.

LOS ANGELES, CAL.—The Union Paving Co. has been awarded the contract for paving Main St. for a distance of 10,986 lin. ft., at $11.80 per ft., or a total of $129,635. The other bids were as follows: Mackay, Young & Austin, $17.22 per lin. ft.; J. P. Smith, $14.61.

OTTAWA, ONT.—The council has voted to pave Rideau St. with asphalt at an estimated cost of $54,518.

MANUFACTURING PLANTS.

LYNN, MASS.—The Union Iron Foundry Co. is reported as to erect a new foundry building, one story, 70 x 30 ft., adjoining the present location at the foot of South St.

NEW BEDFORD, MASS.—Subscriptions for a new heating company are being secured in this city. Press reports state that a considerable part of the apparatus is covered by patents issued to John Demarest, of Malden, formerly connected with the J. F. Pease Furnace Co., of Syracuse, N. Y. Suitable buildings will be erected and about 100 hands will be employed at the start.

WORCESTER, MASS.—It is probable that in a short time an engine of 500 HP. will be put in to replace the present 250-HP. engine at the Millbury Cotton Mills.

CHAUTAUQUA, N. Y.—Press reports state that the American Brewing Co., of Chicago, has purchased 105 acres adjoining the grounds of the Chautauqua Assembly, and it is reported that the company proposes building a brewery.

LOVERSVILLE, N. Y.—Press reports state that a company has been organized at this place, with a capital stock of $50,000, to build a knitting mill.

ROCHESTER, N. Y.—Macauley Plen & Co. will erect a five-story mill on Grave St. Ellsworth & Grant have contract for building, according to reports.

WATERFORD, N. Y.—The Ford Mfg. Co.'s knitting mill was destroyed by fire July 20, with considerable property surrounding it. The loss will amount to about $100,000. The mill will be rebuilt as soon as possible.

COLUMBIA, PA.—The work of rebuilding the Susquehanna Rolling Mill, at this place, which was recently destroyed by fire, has been begun. The new mill will be built entirely of iron, and be much larger than the old one.

GREENVILLE, PA.—It is stated that nearly all the stock has been subscribed for the new Wheeler blast furnace at this place.

NORRISTOWN, PA.—The large mill located a few miles from this place, owned by Edward Clegg, and operated by the Clegg & Brother Carbonizing Co., of Philadelphia, was totally destroyed by fire July 18, causing a loss of $30,000.

BALTIMORE, MD.—It is stated that the flouring mill on Frederick Ave., near Gwynn's Falls, owned by Charles T. Westcott, of Chestertown, will be remodeled and be occupied as a shoe factory, knitting mill, etc.

GREENSBORO, N. C.—The Southern Warehouse & Finishing Co. at this place will erect two cotton spinning and weaving mills near its present finishing mill, both of which will be equipped with the most modern machinery, yet to be contracted for, and an electric light plant.

KINGS MOUNTAIN, N. C.—The Dilling Cotton Mill Co., at this place, will double the capacity of its plant at once. Address the secretary, at Kings Mountain, N. C., or H. S. Chadwick, Charlotte, N. C., who has just been elected president of the company.

MOUNTAIN ISLAND, N. C.—A factory is being built at this place for the purpose of manufacturing seines and nets, and kindred goods. Some of the machinery for the equipment will be removed from a plant at Baltimore, but some new machinery will also be needed. Gen. Man., W. T. Jordan, Mountain Island.

NEWHOPE, N. C.—A company with a capital stock of $250,000 has been organized to build a cotton mill at this place, and the subscription books were opened last week. The equipment will include an electric light plant. Address Rufus Amis, Pres., Oxford, N. C., or W. M. Raker, Vice-Pres., Blue Wing, N. C.

SALISBURY, N. C.—A new cotton mill, to cost $60,000, is to be built and equipped at once at this place by a company composed, in part, of the following citizens of Salisbury, either of whom can be addressed for particulars: J. S. McCubbins, P. H. Thompson, N. B. McCandless. It will be a spinning mill, and the equipment will probably include an electric light plant.

SPENCER, N. C.—The cotton mill at Spencer Mountain will put in 3,500 additional spindles at once. Address Laban Lineberger, Pres.

ANDERSON, S. C.—J. L. Glenn, W. F. Cox, P. K. McCully and others are reported as organizing a company to erect a cotton seed oil mill. Capital stock, $25,000.

SOUTH PITTSBURG, TENN.—The Shuster Foundry Co. is reported about to enlarge its foundry and pipe works.

BELLAIRE, O.—The Bellaire Nail Works will soon begin the erection of a new mill for making sheet bars, tinplate bars, skelp iron, bridge plates, etc., according to press reports. The works have been making sheet bars for the open market for some time, but propose to increase the capacity.

CLEVELAND, O.—The Otis Steel Works Co. is reported as about to enlarge its plant and to erect two new blast furnaces.

CHICAGO, ILL.—Mill No. 4 of the National Linseed Oil Co. at the crossing of Canal St. and the Burlington railway tracks, was totally destroyed by fire July 21, causing a loss of nearly $800,000.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

LEVEE WORK.—Memphis, Tenn.—Bids are asked until July 29 for constructing a levee in the White River levee district. Capt. Graham D. Fitch, U. S. Engr. Office.

SEA WALL.—Detroit, Mich.—Bids are asked until Aug. 5 for constructing a sea wall on Detroit River front, Fort Wayne, Mich. First Lieut. H. L. Roberts, Q. M., U. S. A.

DREDGING.—St. Augustine, Fla.—Bids are asked until Aug. 21 for dredging in Negro Cut, Indian River, Fla., as stated in our advertising columns. First Lieut. A. M. D'Armit, U. S. Engr.

STREET CLEANING.—Buffalo, N. Y.—Bids were opened July 19 for street cleaning for three years. Cooper & Hawkins were the lowest bidders on dis-

tricts 1, 4, 6 and 7; John Martin & Co., districts 2 and 3; Nachtrieb, Beyer & Meyer, district No. 5; C. D. Zimmerman, district No. 8. The total of the lowest bids was $93,085 per year.

DOCKS, PIERS AND WAREHOUSES.—Norfolk, Va.—Bids are asked by the Norfolk & Carolina R. R. Co. until Aug. 3 for constructing docks, piers and warehouses at Pinners' Point, Va., as stated in our advertising columns. The work includes 235,000 cu. yds. of dredging, 76×400 ft. and 88×400 ft. piers, and 60×400 ft. and 72×400 ft. warehouses. The company will furnish all materials. G. M. Serpell, Gen. Man.

SEA WALL.—Orient, N. Y.—Press reports state that five engineers are at work surveying for a location for the sea wall that is to be erected to prevent the water cutting Orient off from the mainland. The sea has made such inroads in the narrow peninsula that the residents petitioned the government and secured an appropriation of $15,000 to build a wall on the Sound side, and a powerful bulkhead of wood and stone on the bay side of the peninsula.

CONTRACT PRICES.

EXTENDING WATER MAINS.—Monmouth, Ill.—Thos. S. McClanahan, Cy. Engr., writes us that all the bids for extending water mains exceeded the appropriation, and that the pipe has been purchased privately at $23.80 a ton, f. o. b. cars Monmouth, and the contract for pipelaying and calking at 12 cts. per lin. ft.

SEWERS.—Rutland, Vt.—Sidney Smith, Cy. Engr., has sent us a detailed statement of the bids received July 13 for constructing sewers. The city furnishes pipe, specials and all ironwork. The contractor furnishes all other material and labor. Subdrains are to be laid in the same trenches, directly under the sewer, to lower the level of subsoil water. These are surrounded with screened gravel, covered with jute bagging, and are from 4 to 7 ins. in diameter. The total bids for the Forest St. sewer were as follows: Frank L. Allen, Worcester, Mass., $6,180; Trumbull & Ryan, Boston, $10,169; Andrew W. Bryne, Boston, $7,335; work will include 1,300 ft. of 8-in. pipe sewer, 9.8 ft. trench, in sand, and 4,200 ft. of 6-in. pipe sewer, 8.2 ft. trench, in sand and clay. For the West St. sewer, 1,200 ft. of 41×50-in. brick, 9.9-ft. trench, sand and clay, F. L. Allen bid $10,210 and A. W. Bryne, $11,015. The bids for trunk sewer No. 2 were as follows:

Quantities.		Frank L. Allen.	Andrew W. Bryne.	Trumbull & Ryan.	Pete. Morgan, Kingston, N. Y.
Trench for 30-in. pipe	2,400 lin. ft.	$0.95	$1.00	$1.10	$1.98
" " 24-in. "	1,900 " "	.95	.90	1.00	1.80
" " 18-in. "	700 " "	.50	.70	1.00	1.70
" " 12-in. "	1,300 " "	.50	.70	.95	1.50
Brick, Am. cem.	70 cu. yds.	13.50	13.50	15.00	12.00
" Port. "	10 " "	16.00	15.50	16.00	16.00
Concrete, Am. cem.	60 " "	6.00	6.50	6.50	6.50
" Port. "	40 " "	7.50	8.00	7.50	9.00
Rubble, Am. cem.	10 " "	5.00	7.00	7.00	6.00
Laying 30-in. pipe	1,200 lin. ft.	.40	.70	.30	.60
Same with gasket	1,200 " "	.40	.70	.30	.75
Laying 24-in. pipe	1,000 " "	.30	.50	.25	.50
Same with gasket	900 " "	.30	.50	.25	.60
Laying 18-in. pipe	400 " "	.25	.40	.20	.40
Same with gasket	300 " "	.25	.40	.20	.50
Laying 12-in. pipe	700 " "	.20	.20	.18	.30
Same with gasket	600 " "	.20	.20	.18	.40
Laying subdrains	6,300 " "	.35	.30	.60	.30
Lumber	20 M. ft.	30.00	40.00	30.00	20.00
Excavation	100 cu. yds.	1.00	1.00	.60	.60
Totals		$11,770	$14,454		
			$13,350		$18,893

[1] Average cut, 7.8 ft., gravel. [2] Average cut, 9.6 ft., clay. [3] Average cut, 6.9 ft., clay; [4] Average cut, 7.9 ft., clay and sand.

WATER-WORKS SUPPLIES.—Camden, N. J.—Contracts for water-works supplies for the ensuing year have been awarded as follows: Camden Iron Works Co., cast iron pipe—3-in., $26.55 per ton; 4-in., $23.95; 6-in., $23.47; 8-in., $23.47; 10 and 12-in., $23.05; 16, 20 and 30-in., $22.45; special castings at 2½ cts. per lb. A. J. Fullmer & Co., of Camden, corporation stops—½-in., $6.50 per dozen; ¾-in., $7.90; ¾-in., $11.75; 1-in., $18. Nathan Traver & Co., of Philadelphia, 20,000 lbs. of pig lead at 3⅝ cts. per lb. Bourne, Scrinzer & Co., cylinder oil at 55 cts. per gallon. Anthony P. Smith, of Newark, was awarded the contract for furnishing sleeves and valves for tapping machines. A number of bids were received for furnishing fire hydrants, but were laid over. Edwin Hillman, Chn. Com.

SEWERS.—Winnetka, Ill.—F. H. Eno, Supt. Pub. Wks., writes us that the contract for constructing the Cairnduff sewer system has been awarded to Maurice J. Healy; character of soil is hard yellow clay throughout. The bids were opened July 2, and were as follows:

Bids Received for Constructing the Cairnduff Sewers, Winnetka, Ill.

Quantities.		Maurice J. Healy, Chicago, $9,217.	H. Hild & Co., Chicago, $9,899.	McNulty & McCarthy, Chicago, $9,945.	David Hardin, Chicago, $10,102.	T. F. Rowan, Chicago, $10,234.	James Henly, Chicago, $10,772.	H. D. Hallett, Aurora, $11,061.	N. F. Reichert, Racine, Wis., $11,090.	M. C. Sloan, Chicago, $11,439.	Edw. Connor, Chicago, $12,106.	John Henly, Chicago, $12,277.	A. W. Fletcher, Highld Pk., $13,936.	M. M. Ellignett, Evanston, Ill. $14,965.
15-in.	10.8 ft. deep.. 460 ft.	$0.60	$0.55	$0.78	$0.54	[2] .78	$0.91	$0.65	$0.75	$0.67	$0.65	$0.80	$1.00	$0.90
12-in.	10.8 " " .. 270 "	.52	.48	.71	.47½	.72	.88	.50	.60	.70	.68¾	.70	.65	.81
12-in.	14.0 " " .. 260 "	.75	.87	.78	.52	.85	.91	.70	.60	1.12	.68¾	.70	.65	.96
12-in.	12.2 " " .. 235 "	.65	.57	.70	.49½	.80	.84	.60	.60	.85	.55	.70	.65	.90
10-in.	10.4 " " .. 200 "	.48	.44	.67	.42¼	.65	.53	.50	.45	.55	.58¾	.54	.55	.78
12-in.	14.0 " " .. 540 "	.75	.87	.78	.52	.85	.91	.70	.60	1.12	.68¾	.70	.65	1.08
12-in.	10.8 " " .. 700 "	.55	.48	.67	.47¼	.65	.73	.50	.60	.70	.58¾	.70	.65	.94
12-in.	9.1 " " .. 570 "	.45	.40	.66	.40½	.60	.57	.50	.60	.68	.68¾	.70	.65	.87
10-in.	7.3 " " .. 440 "	.38	.32	.40	.33¾	.38	.43	.39	.45	.49	.55	.54	.55	.48
8-in.	7.3 " " .. 340 "	.25	.27	.27	.28	.30	.35	.30	.35	.44	.50	.42	.50	.40
12-in.	11.0 " " .. 470 "	.65	.49	.68	.47¼	.72	.78	.50	.60	.70	.58¾	.80	.65	1.00
10-in.	9.4 " " .. 400 "	.38	.38	.40	.35¾	.40	.53	.45	.45	.50	.55	.54	.55	.78
15-in.	9.3 " " .. 900 "	.58	.50	.74	.47½	.60	.68	.90	.75	.62	.65	.80	1.00	.90
8-in.	8.2 " " .. 315 "	.38	.30	.31	.29	.28	.37	.35	.35	.42	.50	.43	.50	.45
12-in.	9.8 " " .. 415 "	.37	.41	.67	.41½	.60	.58	.70	.60	.60	.58¾	.70	.65	.90
8-in.	9.1 " " .. 380 "	.35	.32	.28	.30	.35	.49	.40	.35	.45	.50	.43	.50	.55
8-in.	8.6 " " .. 550 "	.28	.31	.27	.29	.35	.37	.35	.35	.45	.50	.43	.50	.60
10-in.	8.3 " " .. 840 "	.34	.34	.42	.32¾	.40	.49	.50	.45	.50	.55	.54	.55	.72
8-in.	10.5 " " .. 460 "	.45	.34	.29	.33¾	.45	.49	.40	.35	.50	.50	.43	.50	.60
8-in.	8.0 " " .. 1,170 "	.24	.29	.27	.28	.28	.35	.37	.35	.38	.50	.43	.50	.60
10-in.	10.1 " " .. 550 "	.45	.43	.64	.41½	.50	.50	.50	.45	.55	.55	.54	.55	.84
8-in.	9.9 " " .. 280 "	.38	.33	.29	.35¾	.35	.47	.32	.35	.50	.50	.43	.50	.72
8-in.	8.2 " " .. 700 "	.28	.30	.27	.29	.35	.35	.35	.40	.50	.50	.43	.50	.60
10-in.	11.2 " " .. 400 "	.55	.47	.31	.43½	.55	.53	.50	.45	.68	.55	.54	.55	1.00
10-in.	8.3 " " .. 445 "	.34	.34	.27	.34½	.40	.41	.45	.45	.45	.55	.54	.55	.70
8-in.	8.1 " " .. 1,205 "	.27	.29	.27	.28¾	.28	.35	.39	.35	.40	.50	.43	.50	.59
8-in.	8.9 " " .. 1,520 "	.27	.31	.27	.30	.28	.39	.40	.35	.42	.50	.43	.50	.55
Total for 15,015 ft. of pipe		$6,129	$5,966	$6,766	$5,539	$6,898	$7,876	$7,253	$6,992	$8,370	$8,284	$8,254	$8,870	$10,797
Manholes	64...	$14.00	$17.00	$16.00	$19.40	$16.00	$15.00	$18.00	$20.00	$17.00	$15.50	$18.40	$20.00	$20.00
Ex. length manholes.	78 ft.	1.50	3.00	1.00	1.56	1.50	1.25	5.00	2.00	2.00	3.50	1.00	2.50	1.00
Catchbasins	89...	17.50	17.00	21.00	27.70	19.50	17.90	20.00	28.00	20.00	23.00	23.95	35.00	30.00
6-in. junctions	600...	.75	1.60	.30	....	.70	.35	.70	.25	.24	.75	.90	.70	.25
8-in. "	80...	.85	1.60	.35	....	.50	.45	.70	.25	.40	.75	1.20	.70	.25

SEWERS.—Bradford, Pa.—P. B. Winfree, Cy. Engr., writes us that the following bids were received July 1 and opened July 15 for constructing sewers in sewer district No. 11, all the bidders being residents of Bradford:

Quantities.		Jno. Sheehan & P. McGhan.	Jas. Carr.	M. McMahon.
Excav., per cu. yd.,	2,940 cu. yds.	$0.40	$0.44	$0.40
15-in. pipe sewer,	1,895 lin. ft.	.47	.37	.35
12-in. " "	1,560 " "	.32	.26½	.30
10-in. " "	1,550 " "	.27	.23½	.20
15-in. Y-branches,	40	2.00	1.37½	1.30
12-in. " "	100	1.40	1.01½	.90
10-in. " "	100	1.05	.83½	.75
Manholes,	9	30.00	28.00	27.00
Totals		$3,579	$3,264	$3,079

EXTENDING WATER MAINS.—Marblehead, Mass.—The "Messenger" states that the water commissioners have awarded the contract for laying pipes in Clifton and Green Sts., Mechanic and Goodwin's Courts and Harbor Ave. to F. A. Snow & Co., of Boston, at the following prices: 5,000 ft. of 8-in. pipe, 25 cts.; 3,000 ft. 6-in. pipe, 22 cts.; 500 ft. 4-in. pipe, 19 cts.; ledge work, $4 per cu. yd.

SEWERS.—Cincinnati, O.—The contract for constructing the Carthage Pike trunk sewer has been awarded to Wilson & Strack, of Cincinnati. The work was estimated to cost $115,705. The bids were as follows:

Bids for Constructing Trunk Sewer in Carthage Pike, Mitchell Ave. and Right of Way to Mill Creek, Cincinnati, O.

Quantities.		Herman Suer & Co., Cincinnati, O.	Branham & Geet, Cincinnati, O.	Kirchner & Folz, Cincinnati, O.	Bartow & Clements, Hamilton, O.	Wilson & Jackson, Chicago, Ill.	Ulrich, Niesly & Williams, Springfield, O.	SamuelSkuse, Cincinnati, O.	Henkel& Sullivan, Cincinnati, O.	George Ashman, Cincinnati, O.	Wilson & Strack, Cincinnati, O.	P. N. Jonte & Co., Cincinnati, O.	T. A. Tierney Cincinnati, O.	Evan Evans & Co., Cincinnati, O.	Henry Frank, Cincinnati, O.	J. Delaney, Cincinnati, O.	B. D. Barton, Cincinnati, O.
11-ft. sewer, open cut	1,950 lin. ft..	$15.37	$15.12	$15.25	$14.75	$14.40	$13.35	$16.00	$19.30	$16.45	$11.83	$20.25	$14.63	$14.19	$14.72	$13.30	$17.50
11-ft. " tunnel..	300 " "	48.45	37.28	28.00	20.00	21.90	33.35	30.00	32.00	34.00	25.00	20.25	31.70	52.00	49.30	30.00	46.00
9½-ft. "	1,550 " "	13.42	13.47	13.00	11.50	13.90	11.00	14.00	15.50	11.20	10.39	13.50	13.11	12.30	12.72	11.65	11.36
7½-ft. "	2,400 " "	6.85	8.59	8.11	9.50	6.60	6.48	7.70	10.00	6.40	5.80	9.40	6.88	7.82	6.95	6.33	6.00
6-ft. "	100 " "	5.81	5.33	5.97	3.42	4.90	5.50	6.20	5.00	5.00	4.91	5.00	5.82	5.31	5.43	5.20	6.00
5-ft. "	100 " "	4.33	2.95	4.15	2.63	3.90	3.34	4.20	4.00	3.00	2.76	3.00	3.59	3.02	3.05	2.80	5.00
4-ft. "	100 " "	3.15	2.45	3.59	2.35	3.90	2.75	4.00	3.00	2.50	2.50	2.50	3.02	3.04	2.27	2.30	4.00
3-ft. "	50 " "	2.24	1.90	3.05	2.01	2.90	2.15	3.00	2.00	2.00	2.30	2.00	2.37	2.67	2.00	2.00	3.00
12-in. pipe sewer....	500 " "	.475	.30	.75	.35	.70	.25	.50	.40	.50	.30	.90	.90	.50	.75	.30	.25
6-in. " "	1,000 " "	.30	.19	.20	.18	.12	.09	.15	.10	.25	.12	.40	.40	.10	.15	.10	.09
18-in. " "	100 " "	1.25	.54	1.50	.60	.90	.70	.70	1.00	1.00	.62	1.25	.80	.50	1.00	.60	.50
24-in. " "	100 " "	1.75	.97	2.25	1.15	1.20	1.30	1.40	1.25	2.00	1.25	2.00	1.50	1.25	2.00	1.50	.95
6-in. slants	400.....	.15	...	.20	.12	.25	.50	.15	.15	.40	.25	.30	.15	.15	.15	.25	.30
12-in. "	20.....	.40	...	.50	...	.45	1.00	.50	.50	1.00	.76	1.00	.40	.50	.50	.75	.85
Palmer inlets	20.....	32.00	50.00	28.00	27.00	29.00	20.00	25.00	20.00	25.00	30.00	40.00	35.00	35.00	40.00	28.00	45.00
Manholes	30.....	17.00	33.00	30.00	30.00	19.00	30.00	25.00	20.00	25.00	22.00	30.00	25.00	25.00	20.00	25.00	35.00
Brick masonry	150 cu. yds.	6.00	8.00	10.00	6.90	7.00	10.00	7.00	6.00	7.00	7.00	6.00	9.00	10.00	6.00	7.00	5.25
Rubble "	200 " "	6.50	4.50	4.70	3.60	4.90	8.00	4.00	5.00	5.00	4.00	3.50	4.50	10.00	4.00	3.50	5.00
Concrete	50 " "	2.50	4.25	4.70	4.00	3.90	10.00	4.00	6.00	5.00	4.25	4.00	4.50	20.00	4.00	5.00	5.00
Timber foundations	1,000 B.M.ft.	30.00	20.00	30.00	28.00	24.00	40.00	25.00	30.00	30.00	40.00	25.00	30.00	100.00	25.00	40.00	30.00
Piling	750 lin. ft.	.42	...	.33	.46	.16	.50	.50	.40	.40	.40	.35	.50	.35	.38	.25	.40
Excavation, ...	48,450 cu. yds.	.30	.45	.25	.24	.19	.60	.45	.00¼	.50	.45	.001	.315	.50	.48	.39	.35
Broken stone, ...	3,000 " "	1.00	1.00	.20	1.55	.90	1.00	1.50	1.30	1.50	.25	.90	.80	.80	.01	1.60	1.30
Total		$105,467	$112,958 (Informal.)	$97,458	$96,968 (Informal.)	$89,678	$107,950	$112,667	$104,724	$109,750	$88,536	$98,063	$99,390	$115,966	$108,871	$97,146	$107,263

SIDEWALKS.—Indianapolis, Ind.—Brick sidewalk on Elizabeth St. has been let to B. Porter, at 36 cts. a lin. ft., other bids ranging from 36½ to 41 cts. The work consists of 1,268 ft. of sidewalk 6 ft. wide, 7,776 sq. ft., and 138.5 ft. of double walk, stone and bouldering 4 ft. wide. (Brick sidewalk on Warren St. was let to F. M. Snyder & Co., at 24 cts. a lin. ft., another bid being 29 cts. The work is 1,430 ft. of brick walk 4.5 ft. wide, 6,434 sq. ft., and 99 ft. of double walk stone and bouldering. Cement walk on Ohio St. was let to B. Porter at $1.05 cts. a lin. ft., other bids being $1.07 to $1.12. The work is 325 ft. of walk 9 ft. wide, 2,775 sq. ft. Cement walk on Union St. was let to F. M. Dunn, at 66 cts. a lin. ft., other bids being 69 to 78 cts. The work is 947 ft. of cement walk 6 ft. wide, 5,742 sq. ft. and 20 ft. of double walk, stone and bouldering. Cement walk on Hudson St. was let to B. Porter, at 50 cts. a lin. ft., other bids being 53 and 57 cts. The work is 405 ft. of cement walk 4.5 ft. wide, and 15 ft. of double-walk stone and bouldering. Bid of 9 cts. a lin. ft. for setting curb furnished by property owners was also accepted.

SEWERS.—Amsterdam, N. Y.—F. E. Crane, Engr., has sent us a statement of the bids received July 18 for constructing the Minaville St. sewer extension and Garden and Reid St. drain. The contract was awarded to McGahan & Snyder, at $2,200, the amount of 15-in. sewer being increased to 1,125 ft., with one mannole and one catchbasin added to the table which follows:

Quantities.		P. Fritcher.	Frisco & Bazaara	McGahan & Snyder.
18-in. sewer,	165 ft....	$0.96	$0.92	$0.93
15-in. "	725 "	0.76¼	0.71	0.80
12-in. "	55 "	0.52 3-5	0.46	0.40
8-in. "	900 "	0.49¼	0.57	0.51
Manholes	....6.....	31.00	32.50	31.25
Flush tanks	....1.....	34.00	33.00	32.00
Inspection pipe	1.....	11.75	3.50	4.00
Catchbasins	....6.....	48.00	48.00	41.00
Comb f. t. and m. h.	.....1.....	5.00	8.00	8.00
		$1,754	$1,784	$1,735

IMPROVEMENTS AT NAVY YARD.—Philadelphia, Pa.—The following bids were received by the bureau of yards and docks, Washington, July 17, for improvements at the League Island navy yard: Constructing concrete sidewalks—The Vulcanite Paving Co., Philadelphia, Pa., 15 cts. per sq. ft. for coping and 21 cts. per sq. ft. for sidewalks; American Concrete Construction Co., Camden, N. J., 8½ cts. and 15¾ cts.; Warner H. Jenkins Co., Philadelphia, 15 cts. and 18 cts.; William A. Mundy, Philadelphia, 15 cts. and 17.9 cts.; Delaplaine & West, Philadelphia, 19 cts. and 21 cts.; Carter's Artificial Stone Co., Philadelphia, 18 cts. and 24 cts. Dredging and removing old crib—American Dredging Co., Philadelphia, $10,800; Frank C. Somers, Camden, N. J., $10,875. Constructing a continuation of sea wall—Wm. A. Mundy, Philadelphia, $14,774; I. H. Hathaway & Co., Philadelphia, $17,000. Jos. S. Allen, Philadelphia, $18,589. Scow, with pile-driving

engine and boiler—John Baizley, Philadelphia, $3,280; Eugene H. Cathrall, Philadelphia, $1,925; Alfred Box & Co., Philadelphia, $3,300; S. C. Forsaith Machine Co., Manchester, N. H., $3,595.

HIGHWAYS.—Stapleton, N. Y.—The awarding of contracts for constructing roads in Richmond county, on Staten Island, was noted last week. The bids for the Fresh Kills road were as follows:

Quantities.	De Witt C. Bouker, Jr.	Donovan Bros.	J. T. Furman.	Bernard Mahon.	Martin Murray.	Thomas Redding.
Mac'm p'v'g. 35,000 sq. yds.	$0.78	$0.85	$0.85	$0.85	$0.73	$0.72
Excavation .19,000 cu. "	.25	.30	.29	.20	.26	.26
12-in. culv. pipe. 135 lin. ft.	.65	.40	.40	1.00	.40	.40
15-in. " " .135 " "	1.05	.75	.90	1.20	.55	.50
20-in. " " . 45 " "	2.05	1.40	1.35	2.00	1.07	.65
24-in. " " . 45 " "	3.05	1.80	2.00	3.00	1.47	1.80
Dry rub. mas'y. 5 cu. yds.	2.50	4.00	3.00	3.00	2.00	4.00
Cem. " " " 5 " "	4.50	5.70	6.00	5.00	5.40	8.00
4-in. tile dr'n...800 lin. ft.	.16	.30	.08	.40	.29	.10
Reb'd'g br'k mas'y, per M..	10.00	15.00	20.00	....	20.00	8.00
Point'g b'k culv., per lin. ft.	1.00	1.00	.50	....	1.00	.40
Rel'y'g old pipe cul., per ft..	2.00	.50	.08	....	.50	.15
No. days for compl'n work*.	100	175	125	200	80	100
Totals	$33,022	$36,133		$31,282		
	$36,650	$35,132			$30,862	

* At $3.50.

The bids for the Richmond Terrace were as follows:

Quantities.	Donovan Bros.	Jos. Johnson.	Bernard Mahon.
Macad. renewals .....19,500 sq. yds.	$0.72	$0.58	$0.65
Excavation ..... 4,400 cu. "	.40	.22	.22
New bridge stone..... 1,100 sq. ft.	.60	.70	.50
Old " " rel'd. 2,000 " "	.10	.12	.10
New spec. block pave.. 10 " yds.	3.00	2.25	2.00
Old block pave. rel'd.. 35 " "	.20	.27	.50
8-in. culvert pipe..... 35 lin. ft.	.40	.45	.60
12-in. " " ..... 35 " "	.50	.85	1.00
15-in. " " ..... 35 " "	.80	1.20	1.40
20-in. " " ..... 35 " "	1.40	2.20	2.00
No. days for compl'n work at $3.50.	95	60	50
Totals	$17,138	$14,134	$15,130

The bids for maintenance of the second division were Peter Dougherty, $3,635, and John T. Furman, $4,427. The bids on maintenance of the first division were as follows:

Quantities.	Donovan Bros.	John McQuade.
Labor of men.....2,000 days, at	$1.50	$1.50
Broken stone .....3,000 cu. yds., "	2.20	1.85
Screenings ... .1,000 " "	2.20	1.85
Use of sprinkling carts.... 5 months, "	720.00	690.00
" steam roller ..... 150 days, "	12.50	13.00
" of dump-carts ..... 175 " "	3.00	3.00
" of extra sprink'g cart.. 20 " "	6.00	6.00
Totals	$17,920	$16,445

DREDGING.—Raleigh, Ont.—W. G. McGeorge, County Engr., Chatham, Ont., writes us that the contract for the Raleigh Plains outlet enlargement has been awarded to the Chatham Dredging Co., of Chatham, Ont., at $44,775, which makes the work about 8½ cts. per cu. yd. The work is nearly eight miles in length, from 5 to 10 ft. deep and from 50 to 90 ft. wide. Most of the course is in the line of a large drain and creek, which reaches Lake St. Clair, some three miles further down. To get to the work from the lake, dredges will have to pass two fixed highway and two railway bridges, elevated about 9 ft. above the surface level of the lake. The surveys for this work were made in 1892, and the engineer's estimate was $48,428.

WATER-WORKS.—Hightstown, N. J.—The contracts for works, as advertised in Engineering News, have been awarded as follows: Geo. D. Worrell, Mount Holly, laying 3,300 ft. of 10-in., 3,444 ft. of 8-in., 5,628 ft. of 6-in., and 1,994 ft. of 4-in. pipe, all at 15 cts. per lin. ft.; R. D. Wood & Co., furnishing pipe, $22.55 per ton, and special castings, at 2¼ cts. per lb.; Eddy Valve Co., four 10-in., four 8-in., five 6-in. and two 4-in valves and 27 hydrants, $798; Philadelphia Engineering Co., stand-pipe 100 ft. high, with clear internal diameter of 12 ft., $3,320; W. H. Dilion, Hightstown, foundation, 24 ft. across at bottom, 18 ft. at top and 9 ft. deep, $580; A. R. Anderson, engine house, 40 × 20 ft., $747; Wm. R. Thropp, Trenton, stack, $135; Barr Pumping Engine Co., 300,000-gallon pumping engine, $990; horizontal return tubular boiler, $369. Isaac S. Cassin & Son, Philadelphia, Engrs.; A. S. Voorhees, Chn. Com.

METAL MARKET PRICES.

LEAD.—New York: 3.4 to 3.45 cts. Chicago: 3.1 to 3.2 cts. St. Louis: 3.15 to 3.22 cts.

BARB WIRE.—Pittsburg: $2 for galvanized and $1.35 to $1.4 for plain in carload lots at mill.

FOUNDRY AND PIG IRON.—New York: $12.50 to $14. Pittsburg: $11.50 to $14. Chicago: $12 to $14.

TRACK MATERIAL.—New York: angle bars, 1.4 to 1.45 cts.; spikes, 1.8 to 1.85 cts.; track bolts, 2 to 2.2 cts. with square, and 2.1 to 2.2 cts. with hexagon nuts. Chicago: angle bars, 1.45 to 1.55 cts.; spikes, 1.8 to 1.9 cts.; track bolts, 2 to 2.05 cts. with square, and 2 to 2.1 cts. with hexagon nuts.

NAILS.—Pittsburg: $1.55 per keg for carload lots and $1.65 for less than carload lots, for wire nails at mill; $1.30 and $1.35 for cut nails at mill. Chicago: $1.7 and $1.8 for wire nails, $1.45 and $1.55 for cut nails. New York: $1.7 and $1.8 for wire nails, and $1.45 and $1.6 for cut nails.

RAILS.—New York: $24 at eastern mills and $24.75 at tidewater; old rails, $13.50 to $14 for iron, and $11 to $11.50 for steel; light rails, $24; girder rails, $26. Pittsburg: $22 for standard sections of 45 lbs. and over; $23 for light sections; old rails, $16 for iron and $14.50 for steel. Chicago: $25 to $27 for standard sections; $25 for light sections; old rails, $13 to $14 for iron and $8.50 to $12 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.65 to 2.1 cts.; channels, 1.65 to 1.75 cts.; angles, 1.5 to 1.6 cts.; tees, 1.8 to 1.9 cts; universal mill plates, 1.75 to 1.8 cts.; steel plates, 1.65 to 1.9 cts. for tank, 1.75 to 1.95 cts. for shell, 1.95 to 2.05 cts. for flange, 2 to 2.25 cts. for ordinary firebox, 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.5 to 2.1 cts.; channels, 1.5 to 2.1 cts.; angles, 1.35 to 1.4 cts.; tees, 1.8 to 1.6 cts.; Z-bars, 1.5 to 1.6 cts.; universal mill plates, 1.5 to 1.6 cts.; steel plates, 1.6 to 1.8 cts. for tank, 1.7 to 1.9 cts. for shell, 1.8 to 2 cts. for flange, 2 cts. for ordinary firebox, and 2 to 4 cts. for locomotive firebox. Chicago: beams, 1.7 to 1.8 cts.; channels, 1.7 to 1.8 cts.; angles, 1.6 to 1.7 cts.; tees, 1.75 to 1.85 cts.; universal plates, 1.85 to 1.95 cts.; steel plates, 1.75 to 1.85 cts. for tank, 2.1 to 2.25 cts. for flange, 2.5 to 2.7 cts. for ordinary firebox, and 4.5 to 4.75 for locomotive firebox.

INDUSTRIAL NOTES.

THE JEFFERSON IRON WORKS, of Steubenville, O., will resume operations under the control of a new receiver.

HAY & WRIGHT, of Alameda, Cal., are building a large dredge for constructing levees on the San Joaquin River.

THE OTIS STEEL WORKS CO., of Cleveland, O., proposes to enlarge its plant and to erect two new blast furnaces.

THE BOIES STEEL CAR WHEEL CO., of Scranton, Pa., has a large number of orders on hand, and has made an increase of 10% in wages.

THE PENNSYLVANIA TUBE WORKS, of Pittsburg, Pa., is reported as having leased for two years the plant of the Keystone Rolling Mill Co.

THE WEST VIRGINIA METALLIC PAINT CO., of Piedmont, W. Va., has commenced the manufacture of paint at its new works at Keyser, W. Va.

THE ENSIGN MFG. CO., of Huntington, W. Va., has orders for Russell snow plows for the Lake Shore & Michigan Southern and Michigan Central railways.

THE LAUGHLIN NAIL CO., of Martin's Ferry, O., will resume work at its cut-nail mill, which has 225 nail machines, with an annual capacity of 600,000 kegs.

THE IRONTON STRUCTURAL STEEL CO., of Ironton, Minn., will soon start up its works with a full force. The works were completed in 1893, and have a capacity of 30,000 tons a year, but have only been operated on a small scale.

THE BALDWIN LOCOMOTIVE WORKS, of Philadelphia, Pa., is building a double-end express engine for the Chicago, Burlington & Quincy R. R. It will have cylinders 19 × 26 ins., four coupled driving wheels and a leading and trailing pony truck.

THE PITTSBURG METER CO., of Pittsburg, Pa., is the new name of the Fuel, Gas & Mfg. Co., the change having been made in order that the corporate title may more clearly indicate the nature of the company's business. Secy., A. G. Holmes.

THE ATLANTIC IRON WORKS, of Sharon, Pa., is to resume operations. It has 32 puddling furnaces, 8 heating furnaces, 6 trains of rolls and 40 nail machines. It produces bar, plate, hoop, rod iron and nails, its annual capacity being 27,000 tons.

THE HARRISBURG FOUNDRY & MACHINE WORKS, of Harrisburg, Pa., is building two 600-HP. engines for the Wilkes Barre Traction Co., and two large engines for the electric lighting plant of the Spitzer Building, Toledo, O. All the engines will be coupled direct to the generators.

CURRAN & HUSSEY, engineers and contractors, of Pittsburg, Pa., have received the contract for thoroughly overhauling the track of the Washington St. Ry. Co., Washington, Pa., and building an entirely new overhead system for the same, adding a mile or more of new track and building a car barn.

THE READING IRON CO., of Reading, Pa., will operate all four of its furnaces, giving an aggregate capacity of 80,000 tons. Until recently only two furnaces have been in operation. The company has acquired the plant of the Montour Iron & Steel Co., at Danville, Pa., which was recently sold by the sheriff.

THE MOOREHEAD & McCLEANE ROLLING MILL, of Pittsburg, Pa., recently acquired by the New York Life Insurance Co., which held a mortgage on the property, has been sold to C. F. Stuart, of Cleveland, O., and the mill and blast furnace are to be started up soon. The plant has been shut down for over a year.

THE BUILDERS' IRON FOUNDRY, of Providence, R. I., announces that it has added to its business a department for the manufacture and sale of a full line of wood wheels and grinding and polishing machinery, with suitable countershafts of novel design. The sales department will be in charge of Wm. C. Buell, who has recently become associated with this firm.

THE INMAN BROTHERS CONSTRUCTION CO., of 136 Liberty St., New York city, has had Thomas S. Hume appointed as receiver, and judgments have been obtained against the company, which has had contracts for laying water mains in several towns. Pres., George A. Inman. The company was incorporated under the laws of New Jersey in 1893, with a capital stock of $750,000.

THE CONSOLIDATED AMERICAN REDUCTION CO., of New York city, has been incorporated, and is a consolidation of the American Reduction Co. and the International Reduction Co. with the United States Alumina Phosphate Co. The company is to gather garbage refuse and manufacture fertilizer. It has a capital of $400,000, and will do business in New York, Syracuse and Utica. The directors are Samuel M. Roosevelt, N. B. Powter and R. W. G. Welling, of New York; D. R. Case, of Bristol, R. I., and John B. Campbell, of Brooklyn, N. Y.

THE F. D. CUMMER & SON CO., of Cleveland, O., manufacturing the well-known Cummer dryers, report among recent sales one clay dryer to the Glens Falls Portland Cement Co., Glens Falls, N. Y.; one sand dryer to the Silica Portland Cement Co., Glens Falls, N. Y. There are a number of cement works using this company's revolving clay and marl dryers, also their direct heat tunnel drying systems, and the Empire Portland Cement Works, at Warner's, N. Y., has two large revolving clay dryers and a 24-tunnel system furnished by this concern.

THE GOULD STEAM FORGE & AUTOMATIC COUPLING WORKS of Buffalo, N. Y., had its Black Rock branch destroyed by fire July 22, involving a loss of about $70,000. The plant comprised a forge shop, machine shop, sand shed and scrap shed, all frame buildings, occupying about half an acre on ten acres of property owned by the company. A number of patterns were destroyed. It is said that perhaps the works will not be rebuilt, as the company's main works are at Depew, N. Y. The plant had been in operation since 1888, and about 100 men are thrown out of employment.

THE STANDARD ELECTRIC CO., of Chicago, Ill., has made a statement, through D. P. Perry, Gen. Man., to the effect that the daily reports from its traveling men, local correspondents and customers comment on the bright outlook, and the cheerful and healthy tone pervading nearly every line of industry in nearly every community in the West and the South. Correspondents lay especial stress on the plans that are being laid, or work already contracted for, in the line of improvements and extensions by individuals and private corporations as well as public corporations, and many and large appropriations have been made for municipal improvements of every character, from electric lighting plants to bridge building and from street paving to extensions of water plants.

NEW COMPANIES.—J. H. Williams & Co., Brooklyn, N. Y.; $300,000; tool, forgings and machinery; James H. Williams, Wm. C. Redfield and Wm. J. Grindon.

Century Building Co., St. Louis, Mo.; $1,000,000; A. O. Rule, C. W. Wall and John B. Krieger.

Missouri Construction Co., St. Louis, Mo.; $100,000; O. W. Hester, C. A. Cunningham and Scudder Hinde.

Home Standard Telephone Co., Albany, N. Y.; $350,000; Henry Russell, Charles L. Whitley, and John M. Barley.

Mercantile Gas & Electric Light Co., San Jose, Cal.; $500,000; J. V. McKiernan, Frank Whitaker and W. W. Wood.

Elmira & Gaines Oil & Gas Co., Elmira, N. Y.; $25,000; Thomas S. Flood, Howard H. Hallock and Boyd McDowell.

Monarch Brick Co., Los Angeles, Cal.; $100,000, all paid in; Charles H. Whitman, Andrew B. Workman and John E. Vawter.

A. G. Newman Power Pumping Co., Des Moines, Ia.; to manufacture pumps; $40,000; A. G. Newman, J. A. Johnson, Jr., and O. E. Atkinson.

Peninsular Machine Co., Grand Rapids, Mich.; $10,000; Pres., M. L. Fitch; Vice-Pres., and Gen. Man., M. Lund; Sec., Frank Edge.

High Dam Power Co., Oswego, N. Y.; to develop the water power of the "high-dam" at Oswego; $100,000; Suits C. Conde and George N. Burt.

New Castle Asphalt Block Co., New Castle, Pa.; $80,000; Samuel C. Graham, Albert F. Brown and Walter S. Burchinal, all of Pittsburg, Pa.

Western Compressed Air & Construction Co., Chicago, Ill.; to manufacture machinery; $500,000; Ralph R. Bradley, Wm. Fletcher and Frank E. Pratt.

Morris Chute Co., Camden, N. J.; switchback railways and water toboggans; $250,000; Edward J. Morris, Wm. J. Thompson and R. J. Thompson.

Perkins Electric Switch Co., Hartford, Conn.; increase of capital stock from $50,000 to $125,000. C. G. Perkins, Roland Mather and P. H. Woodward.

Neff Air-Power, Water-Works & Fire Extinguisher Co., Fort Wayne, Ind.; $100,000; Charles Pape, of Fort Wayne; Preston F. Miles and E. W. Higbee, of Milford.

New Jersey Heat & Power Co., Jersey City, N. J.; $100,000, with $5,000 paid in; James C. Hinchcliff., Paterson, N. J.; Wm. B. Rockwell and F. A. Phelps, Newark, N. J.

Crandall Electric Signal Co., Jersey City, N. J.; $500,000, with $5,000 paid in; Lucien S. Crandall, Parish, N. Y.; James Curran, Hoboken, N. J.; Geo. B. Fielder, Jersey City, N. J.

Old Dominion Copper Mining & Smelting Co., Jersey City, N. J.; $3,750,000, with $1,000 paid in; Isaac Lewiston and Wm. R. Montgomery, of New York city; Edgar Buffum, of Newark, N. J.

Morris County Iron Ore Co., Rockaway, N. J.; $240,000, with $1,000 paid in; Joseph S. Cunningham, Paterson, N. J.; Edward C. George, Pompton, N. J.; and Abraham V. Remsen, New York city.

Colorado & Wyoming Construction Co., Camden, N. J.; $25,000, with $2,000 paid in; Wm. T. Carpenter, Grand Junction, Colo.; Harry A. Woodsworth, Denver, Colo.; Jos. E. P. Abbott, May's Landing, N. J.

Webber Brake Co., Jersey City, N. J.; $50,000, with $1,000 paid in; brakes for electric and street cars; George O. Lord, Clifton, N. Y.; F. S. Greene, 21 Trask Ave., Bayonne, N. J.; Otto R. Saint, 135 W. 81st St., New York city.

A WISE CONCLUSION.

1413-1417 Chamber of Commerce,
Chicago, July 6, 1895.

Gentlemen:

We have concluded hereafter always to advertise our lettings in the Engineering News, as we find we have received more bids from an advertisement in your paper than any other publication.

Yours truly,
Hill & Enricht,
Civil and Consulting Engineers.

CONTRACT WORK

of all kinds, and in any section of the United States or Canada, should be advertised in Engineering News which is probably read by a greater number of prominent contractors each week than are any other five papers in this country.

RECEIVED TOO LATE.

We continue to receive proposal advertisements and news items on Thursday morning for insertion in the issue of that week. The first pages of Engineering News go to press on Tuesday and the last pages on Wednesday afternoon of each week. All matter for publication should be received by Wednesday noon.